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Vertical Spindle Milling Machine.

Though milling machines having horizontal spindles are used in this country, almost to the exclusion of those of the vertical spindle type, there can be no doubt that, for many kinds of work, a machine having a vertical spindle is preferable to any other, among other reasons being that the operator can more easily and more clearly see the operation of the cutter, and can more easily follow any irregularity of outline of the surface to be milled. The English and Continental tool builders seem to rather favor the vertical spindle type, and, in fact, are inclined to employ it in some cases where it seems evident that the horizontal spindle machine would be better, the result being, however, that they have been ahead of us in machines of that character.

But on this page we give an illustration of a vertical spindle machine, which, to American eyes, and, presumably to many Europeans as well, will appear to possess many advantages over those heretofore used. The usual knee moving up and down on the face of a column is entirely dispensed with in this construction, and the platen placed on top of a very broad and substantial base, to which it is gibbed solidly, resting upon ample flat surfaces. The vertical adjustment of the spindle is made in the column, which, as will be observed, is very massive and amply sufficient to prevent all vibration and springing. Besides the vertical movement of the column there is a finer vertical adjustment for the spindle by means of a collar nut, which is graduated in thousandths of an inch.

All movements of the machine, either by hand or the automatic feeds, are controlled from the front of the machine, the feeds working in either direction, and being automatically thrown out at any desired point. The platen is 36″ long, 12″ wide, provided with T slots for holding work, its movement, either by hand or automatically, being 36″ longitudinally and 12″ transversely.

The spindle, which is supported in bearings of ample dimensions and having means of adjustment for wear, has a hole passing through it, in which there is a bolt for securing the arbors in the spindle. The end of the spindle when at its lowest point is 1½″ from platen, and at its highest 15″. It has three belt and three gear speeds, which, with two speeds on the countershaft, give a total of twelve different speeds. There are eight changes of feed for each speed of spindle. When desired, a circular milling attachment is furnished, which is 18″ diameter, and has automatic feed in either direction. For surfacing in this machine inserted tooth mills up to 8″ diameter are used by the builders.

On page 2 we give outline cuts of some of the pieces which are being milled in their shops on one of these machines, the result in points of quality and quantity of work accomplished being entirely satisfactory. The surfaces which are milled are indicated by dots. Most of the pieces will be recognized by those familiar with the products of the builders, the Brown & Sharpe Mfg. Co., Providence, R. I.

Forced draught is coming to be looked upon with disfavor in the British navy. It is said that a trial trip made under forced draught does more injury to the boilers than four years of ordinary use.

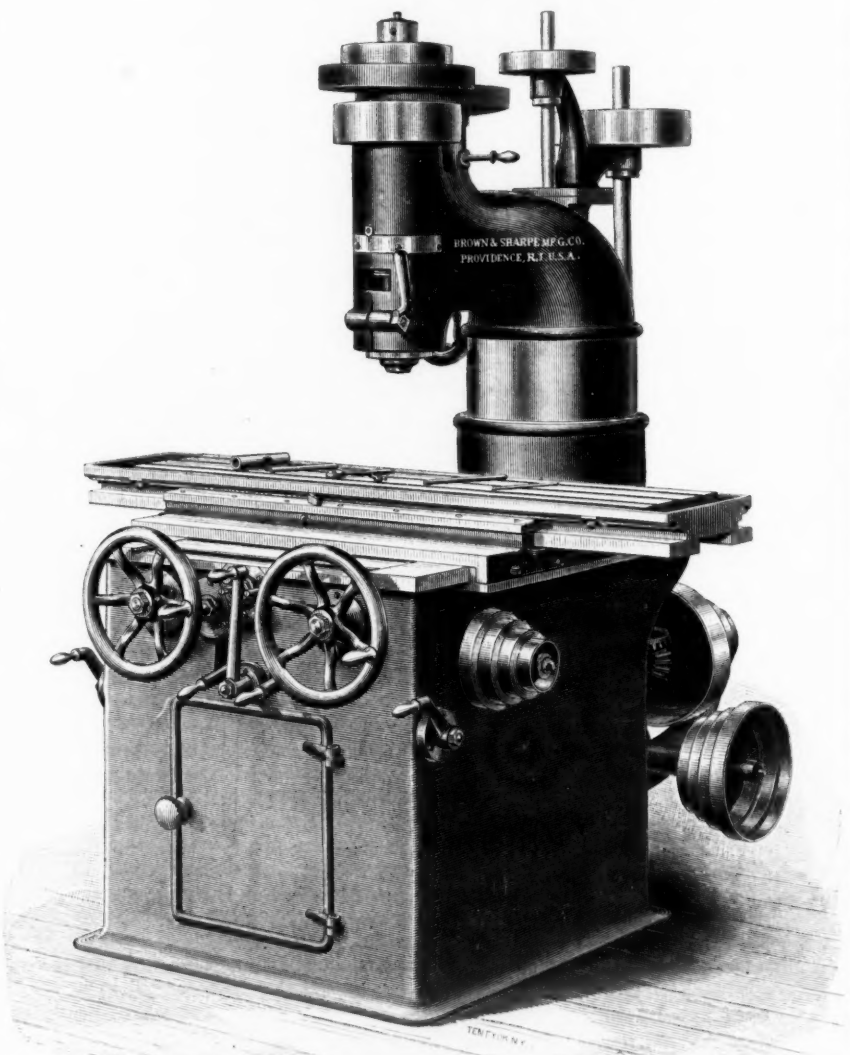
A Scrap-book Substitute.

The value and advantage of having some system of preserving and classifying newspaper clippings, and other matter relating to mechanical subjects, is generally recognized by those who have to do with mechanical matters, and there can be no doubt that a method which affords a means of filing away anything relating to a given subject connected with mechanics in the shortest possible time, and in such a way as to afford facilities for referring to it when wanted, without trouble and without loss of time, is a great advantage—so great an advantage that only those who have experienced the satisfaction attending the use of such a system can realize its importance. But the great difficulty is to devise a system which fulfills the conditions mentioned. The scrap-book system is a failure, for the reasons that too much waste of time and bother attend the use of paste or mucilage, and also because, where there is anything like a thorough separation of matter into classes, the books become too bulky, while, if the other plan of pasting in the scraps solidly, just as they come, and then indexing them, is resorted to, the various pieces relating to a given subject may be widely separated, and even be scattered through a number of books, making their use very inconvenient.

Mr. Wm. M. Barr, who is at the head of the Barr Pumping Engine Co., has tried a number of plans, and, becoming disgusted with them, one after another, has at last hit upon a system which it seems is about as near perfection as there is hope of getting.

It may be worth while, before describing this system, to describe briefly the one which he last discarded, if for no other reason than to show how an apparently good system, and one involving some considerable outlay for paraphernalia, may become burdensome, and finally be discarded for something simpler and less expensive. It consisted of a number of sheets of manila paper, the size of an ordinary letter sheet, and perforated at one edge to go into a cabinet letter file. The clippings were pasted on these sheets, those relating to a given subject being kept together, either on one sheet or a number of sheets filed together. These sheets were then filed alphabetically, the same as letters. This worked fairly well, but involved the use of paste, and consumed considerable time. It was given up, and now a drawer of Mr. Barr's desk is partitioned off, so as to hold envelopes made of strong manila paper to stand handling, and about 4″ × 9½″ in size. Into one of these envelopes are put all clippings relating to a given subject, and the name of that subject is written on the upper edge of the envelope. These envelopes stand on edge in the drawer, in alphabetical order, and any one of them can be taken out or put in place in a moment. Besides the clippings, these envelopes will contain copies of patents relating to the subject where they are on hand, and also two sheets of paper just the right size to fit the envelopes, on one of which is noted references to title and page of books or other publications containing articles on the subject, which it is not practical or desirable to cut out. The other sheet will have pasted to it such short items as it is wanted to preserve, and which are so small as to be bothersome if kept loose in the envelope. Of course two or more envelopes for one subject may be used where necessary—one of them, for instance, being devoted exclusively to copies of patents, where there are enough of them relating to a given subject to make this desirable. Where a clipping relates to two or more subjects, and cannot readily be divided, it may be filed under one heading, and a reference to it entered on the sheet provided for references in the envelope devoted to the other subject to which the clipping relates.

This plan not only reduces the work of filing to the minimum, but is capable of indefinite expansion, yet never requires any more room than is actually needed at the time. Dead matter can readily be discarded, without interfering with anything else, and all data relating to a given subject which has been gathered up is together, and can instantly be referred to. The expense attending this plan is very small, and our advice to any mechanic, who has no system of filing clippings, is to immediately inaugurate this one. A young man commencing it now will find, in after years, that it is one of his most valuable possessions.



VERTICAL SPINDLE MILLING MACHINE.

Testing the Forth Bridge.

Two of the 1,700 feet spans of the Forth Bridge were tested on the 21st ult. Two trains, each 1,000 feet in length, and consisting of three engines and fifty cars laden with coal, the total load being 1,800 tons, steamed slowly across the bridge, periodically stopping to enable the engineers to examine the levels and deflections. The trains proceeded as far as the middle of the north cantilever, and then returned slowly. Under this great load, which is more than double what the bridge will ever be called upon in practice to sustain, massed on the centers of the spans, the observed deflections were in exact accordance with the calculations of the engineers, Sir John Fowler and Mr. Baker. The bridge exhibited exceptional stiffness in all directions.

Every part of the bridge will be in order for the visit of the Prince of Wales on the 4th of March. It is believed that the bridge has been more severely tried by the wind load of the storms which it has already successfully withstood. During a heavy gale a few weeks ago, the gauges, it is said, recorded a pressure of 37 pounds per square foot, the maximum lateral movement of the center cantilever was less than one inch.

On the 27th of January last, Mr. and Mrs. Wm. B. Bement, of Philadelphia, completed their fiftieth year of wedded life, and with the assistance of about 400 of their personal friends, some of whom came from long distances to be present, they celebrated their golden wedding anniversary. Many notable people were present, the prominent manufacturers of Philadelphia and other cities being

well represented, as would be expected from the fact that Mr. Bement was for so many years actively identified with them. The house was beautifully decorated, the tables were superb, and altogether the occasion was a very enjoyable one. Our readers, many of whom are personally acquainted with them, will, we are sure, join us in congratulating Mr. and Mrs. Bement, and in the hope that they may be spared to enjoy many more anniversaries of their wedding day.

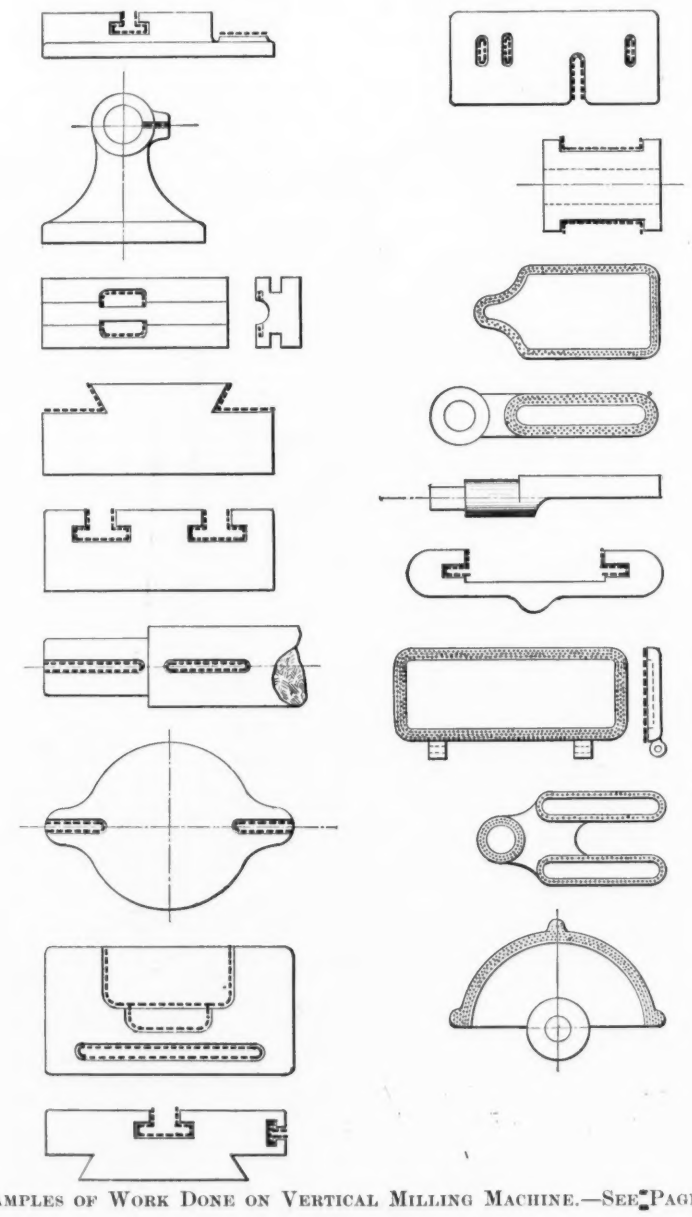
The Colors Produced During the Tempering of Steel.

BY MR. THOMAS TURNER.

(Paper read before the Birmingham Philosophical Society).

It has long been observed, and every steel worker knows, that when bright steel is heated in the air to certain definite temperatures, a series of colors can be obtained, beginning with a light straw, and passing through a succession of brown and purple shades to a deep blue. These colors have attracted the attention of many observers, and suggest questions of interest as to the causes and circumstances of their production, and the physical and other problems therewith connected. In addition, however, to any other cause of interest these colors possess, they have been studied on account of their real and supposed importance in the arts. Every one must be familiar with the different shades of color which are given to steel pens, varying from a very light straw to a deep purple or blue. These various shades are commonly produced by heating the clean, bright pens, in their otherwise finished condition, to a suitable temperature in a revolving cylinder. When the desired color has been obtained the pens are immediately cooled by being turned quickly out onto a sieve or other cooling place, so that the color produced may not change by further heating. The colors of the pens met with in commerce are, however, not quite the same as those produced as above described, since the tints are slightly altered by the lacquer which is used to prevent rusting. Another well-known application of these colors is in the ordinary method of tempering steel, which is a very important, though, in many cases, an extremely delicate operation. After the steel has been hardened, say in the form of a plain drill or chisel or other simple tool, the workman commonly cleans a portion of the surface of the steel, and then once more cautiously heats it until a certain desired color is obtained on the bright surface; the tool is then usually immediately cooled in water. It will be seen, therefore, that the formation of a particular color is assumed to correspond more or less nearly with a certain combination of hardness and tenacity which is required in the tool; and when it is remembered that usually the value of the tool is dependent to a very considerable extent on the temper which is imparted to it, and that the workman judges of this temper by the color of the surface, it will be seen that the study of the properties of these colors is of great importance to thousands of workshops in this country. Further, the whole range of temperature used in tempering steel generally extends only from about 220° to 320° C., or thereabouts, that is, only about 100° C. (though we have good reason to believe that this range is capable of extension); it will be seen, therefore, that it must involve very considerable experience to successfully temper a piece of steel when the operator is obliged to work in the manner above described.

Thus, within the range of only one hundred degrees Centigrade, we have compressed the points which are necessary for the proper treatments of a knife-edge and a cold chisel, a razor and a spring, a steel engraver's tool and a saw, a lancet and a hatchet, tools as opposite as possible in properties and uses, and each and all of which would be entirely unfitted for their purpose if treated improperly during tempering. It is no exaggeration to say that a difference of only ten degrees Centigrade would often exert a considerable influence on the usefulness of a tool, and yet in most cases the workman can only judge of the temperature employed by the color he observes. How far this is a trustworthy guide we shall consider anon, but it is of interest to notice that almost exactly a century ago, on June 9, 1789, a patent (1687) was granted to David Hartley for the use of a "pyrometer or thermometer, or other precise or regulated mode of measuring heat in tempering articles made of steel, instead of the mode hitherto accustomed, of tempering them by color," and Hartley stated that usually the tempering heats "lie between the points of four hundred and six hundred degrees upon Fahrenheit's scale of heat." For delicate work the thermometer has been more or less in use ever since Hartley's time. Several writers (including Aikins, Jeans, and others) have attributed the use of a fusible metal bath, and the determination of color temperatures, as now generally received, to Hartley. Certainly fusible metal and other baths were used early in the present century



SAMPLES OF WORK DONE ON VERTICAL MILLING MACHINE.—SEE PAGE 1.

(see Aikins, *Chemical Dictionary*, 1807, vol. i., p. 604), but I have not been able to establish any connection between these and Hartley, whose patent above quoted gives most general directions for applying heat, evidently without later refinements, and gives no more details of temperature than above quoted. The best and most complete color-tempering scale with which I am acquainted was published in the form of a colored diagram with the *Report of the United States Chief of Ordnance*, 1885, p. 204. Most writers who touch on this subject treat it in a stereotyped manner, stating that when bright steel is heated to a certain temperature, such and such a color is produced, and this is suitable for lancets, chisels, springs, or other articles, as the case may be. It is, therefore, tacitly assumed, though not perhaps actually stated, that a particular color corresponds to a certain temper, and is invariably produced at a particular temperature. In fact, the three things—color, temper and temperature—might, so far as the text-books are concerned, be closely and forever united.

The cause of the production of these colors is now universally, I believe, acknowledged to be the formation of thin films of oxide on the surface of the metal when it is heated in presence of air. Even this question was at one time in dispute, such men as Davy (*Chemical Phil.*, p. 390) and Thomson (*Chemistry*, vol. i., p. 224, taking the opposite view. But Davy afterwards showed (*Thomson's Annals*, 1813, vol. i., p. 131) that steel might be heated in a neutral gas, such as hydrogen or nitrogen, without being colored on its surface, and that steel remained colorless when heated under the surface of oil or of mercury.* I have frequently heated bright strips of polished steel for hours under the surface of mercury or oil without discoloration, while they would have been instantly colored at the temperature used if heated in contact with air. I think, further, that there can be little doubt that the oxide so produced is practically transparent, first, because the sequence of colors is what would be expected in films of a transparent substance when the thickness of the films gradually increases; also because of observations on the reflected light, the color of which varies somewhat at different angles; but chiefly because it is found that on increasing the temperature a little above the point necessary to produce a dark blue, the color gradually disappears (though doubtless oxidation proceeds more rapidly), and the surface, though covered with more oxide, becomes almost colorless again. When it is granted that the colors we are considering are the result of oxidation, it would at once appear probable that the nature of the surface to be heated, its freedom from dirt and grease, and the length of time during which it is heated, would all exert a considerable influence on the shade produced. It would also appear probable that the amount of carbon present in the metal, and the condition in which the carbon existed, would have comparatively little influence. Hitherto my experiments have been chiefly directed to the study of these simple, and, as they appear, almost self-evident conclusions.

* Professor Roberts-Austen has also shown that steel is not colored when heated in vacuo.

Heating has usually been performed in a large air oven, inside of which, about two inches from the bottom, was an iron tray supported on fire bricks, and filled with sand to the depth of about an inch, a small space being left all round the tray so as to prevent contact with the sides of the oven. Resting on the surface of the sand, but not touching the edges of the tray, was a plate of copper, on which were placed the strips of steel it was desired to heat. The object of this arrangement was to prevent irregular heating from below, and to give as much uniformity as possible. Passing through the center of the copper plate, and partly covered by the sand, was the thermometer used; and, as even with these precautions it was not found possible to get perfect uniformity, a considerable number of strips was operated upon at one time, and about four removed, from different parts of the plate, when an observation was made. I am indebted to Messrs. Perry & Co. (late Sir Josiah Mason) for specimens of bright crucible pen steel, both in the soft and in the hardened condition, while Mr. G. H. Strick, of Brynamman, kindly supplied me with samples of bright wrought-iron. It is, of course, necessary that for such experiments the steel to be used should be clean and bright. A rough surface does not give nearly the same brilliancy of color as is noticed when the metal is carefully polished, though the shade is pretty nearly the same in both cases. The presence of dirt usually causes irregular coloring, producing bands or spots of color different to the rest of the surface. Naturally, too, some kinds of dirt appear to assist oxidation, though the shade is less brilliant, while other kinds of dirt exert a protective influence. The brightest shades are produced with perfectly clean and polished surfaces, and few people are aware of the gorgeousness of the shades of purple and blue which can be produced on a large surface with proper conditions.

In connection with the supposed relationship between color and temper, I have taken strips of bright steel, hardened and unhardened, and also bright wrought-iron, and heated them as above described at various temperatures, for definite periods, and find that practically each of these three varieties of iron gives the same colors in the same time. The only difference I have been able to perceive is that the hardened steel gives the brightest color, and the wrought-iron the least brilliant. This difference in brilliancy is no doubt due to the fact that the surface was more perfect in the hardened steel specimen, which had been carefully cleaned by rotation with sand in barrels for a lenghtened period. The fact that in each of the three classes the shade produced under similar circumstances is identical, shows at once that the color on a steel tool is no indication whatever as to the contents of carbon or the temper of the steel. As bearing on this aspect of the question it may be mentioned that Bousfield patented (1866, No. 2810,) a method of bluing the surface of sheet-iron. After the sheets had been properly cleansed they were heated in an air-tight flask for a good many hours at 700° Fahr., care being taken that no two sheets were in contact with each other. Probably a lower temperature, and a shorter time, with free access of air, would produce a similar result. I notice, too, that in some cases cast-iron is colored in a similar manner, and this fact confirms the above conclusions.*

From the very beginning of my experiments I have been struck with the fact that *time* has a most important influence in developing these colors. From a study of ordinary text books one might readily conclude that to produce a light straw color about 221° C. is necessary, while about 320° C. is required to produce a blue color. Such a conclusion would, however, be quite erroneous, for it is easy by heating the specimens

*Dr Percy has given details of the methods used to obtain the bright grey-black coating on Russian sheet-iron (*Manufacture of Russian Sheet-Iron*, 1871). The color in this instance is partly due to carbonaceous matter.

for a comparatively lengthened period to produce a blue color at a temperature below that which is usually regarded as necessary to give a straw color, or over 100° below that which is generally accepted as producing a blue. In the same way a straw color can be produced, in a few minutes, fully 50° below 221° C., which is the generally accepted temperature. It will be found, however, that as we pass from shade to shade up the series, each color requires a longer interval for its production at a given temperature than the one which preceded it. Thus, at a given temperature, we may pass from very light straw to straw—a well-marked change—in a few minutes, while at the same temperature it may require almost as many hours to pass from purple to blue. Further, in starting with low temperatures, the intervals of time between the various shades are greater, and become very considerable indeed for the deeper shades. For example, a purple can be produced at 250° in a few minutes, which would require an hour at 220°, or about twelve hours at 170°, though the ultimate result would be the same in each case.

On the other hand, it can be shown that, with a deficiency of oxygen, iron or steel may be heated far above the temperatures previously mentioned without producing the usual succession of colors. Thus, in annealing sheet-iron in the manufacture of tin plates a number of sheets are heated to redness for some hours in an iron box, from which the air is excluded as far as possible. On removing the sheets when cold they are found to be straw-colored or brown in the center over perhaps ⅞ of their area. Surrounding this center portion, passing outwards in order, are found purple, blue, light blue, blue green, and nearly colorless, depending on the amount of oxidation, though the sheets themselves have been exposed for a considerable time to a red heat. Bousfield's patent, above mentioned, is another example of the same kind. Details of a few of my own experiments, undertaken to try and determine the interval between definite shades, may serve to illustrate these facts. Thus:

Total Time of Heating at 221°-227° C.	Interval between Samples.	Color.
5 min. ..	— ..	Darkstraw.
12 min. ..	7 min. ..	Brown.
21 min. ..	9 min. ..	Brown, with purple.
32 min. ..	11 min. ..	Nearly all purple.
45 min. ..	13 min. ..	Purple, with some blue spots.
60 min. ..	15 min. ..	Very similar.
77 min. ..	17 min. ..	Nearly all blue.
95 min. ..	19 min. ..	Very similar.
117 min. ..	21 min. ..	Deep blue.
140 min. ..	23 min. ..	Blue, with slight tinge of green.

It will be seen on examination of the specimens shown that several of the above colors are "bastards"—*i. e.*, transition colors, and that, although the last interval (twenty-three minutes) is more than four times as long as the first (five minutes), still the early intervals are too long, and the later ones too short. Another experiment gave:

Total Time of Heating at 220°-227° C.	Interval between Samples.	Color.
1 min. ..	— ..	Very light straw.
4 min. ..	3 min. ..	Light straw.
9 min. ..	5 min. ..	Straw.
16 min. ..	7 min. ..	Brown.
25 min. ..	9 min. ..	Brown, with purple.
36 min. ..	11 min. ..	Brown and purple, about equal.
49 min. ..	13 min. ..	Purple, with some brown.
64 min. ..	15 min. ..	Purple, with blue.
81 min. ..	17 min. ..	Nearly all blue.
100 min. ..	19 min. ..	Blue.

In this experiment, though the time of heating varied as the squares of the numbers from one to ten, still the intervals were too short in the later samples, and transition colors were obtained. The earlier samples also were not so definite as might be desired, though it would be difficult to express the slight variations in words. The following was a more successful experiment:

Total Time of Heating at 220°-227° C.	Interval between Samples.	Color.
2 min. ..	— ..	Very light straw.
4 min. ..	2 min. ..	Straw.
8 min. ..	4 min. ..	Dark straw.
16 min. ..	8 min. ..	Brown.
32 min. ..	16 min. ..	Brown, with purple.
64 min. ..	32 min. ..	Purple.
128 min. ..	64 min. ..	Dark blue.
256 min. ..	128 min. ..	Greenish blue.

The three series of steel test pieces as above are exhibited in the room, and it is evident to all that the last of the three experiments gave far the best results, as judged by the distinctness of the shades produced. Hence at the temperature used (220°–227° C., corresponding closely with 221°, commonly accepted as giving a straw color), the time required to pass from one distinct shade of color to the next, increases approximately in geometrical progression. Dr. Poynting has suggested that at the temperatures used in my experiments the film of oxide first formed may act as a protection to the surface of the metal, and that the rate at which the thickness of the film increases may be represented by a logarithmic curve. I do not venture to suggest that a similar rule would hold good for all temperatures, of that I have no evidence; but this is certain, that, at low temperatures, such as, say, 150°, the various colors can be produced, but it requires very prolonged heating in order to obtain the blue shades. On the other hand, the lighter colors can be produced at a high temperature, but require very little time for their development. I have not attempted to determine the lowest temperature at which these colors can be produced, and should imagine it would be difficult to do so accurately. I have, however, succeeded very well at 150°–160° C., and do not doubt, that with sufficient time, a still lower temperature would suffice.

Though the foregoing observations prove that the color developed is dependent as much upon time as upon temperature, and that the color is independent alike of the amount and the condition of the carbon present, so long as the surfaces and other conditions are alike, still these observations merely suggest another and more important question, namely, how far the temper of the steel may be affected, and its properties changed, by continued heating at a temperature below that which is generally employed for tempering. Hitherto I have not been able to obtain quantitative results in this connection owing to the fact that steel strips, even when carefully hardened, not only differ in the various pieces, though cut off the same sheet, and treated in the same manner, but even the same strip will very commonly differ in hardness on the two sides, and not unfrequently, even in a strip of only some three inches in length, one side of the strip will be different at each end, while the middle will not agree with either. Hence some more satisfactory method of experiment is required; but in the meantime I have satisfied myself that hardened steel strips, if heated for some hours at 220° C., are distinctly softer than similar strips which have been heated for a shorter time; and that, though a few minutes at 220° produces a distinct effect, the interval has to be considerably increased from time to time, in order to produce further and further appreciable softening of the steel. I am informed that the experience of steel pen manufacturers lends support to the above opinions, and I may venture, in conclusion, to refer to other observations in the same direction. Brande (*Chemistry*, 1848, vol. i., p. 759) gives the following interesting details in reference to the preparation of knife-edges for a pendulum used by Captain Kater (*Phil. Transactions*, 1818, p. 38), the details of which preparation were not given in Captain Kater's original paper. Brande states that the knife-edges "were forged by Mr. Stodart from a piece of fine wootz; they were carefully hardened and tempered in the bath at 430° Fahr.; on trial they were found too soft. They were a second time hardened, and then heated to 212°. The intention was to increase the heat from that point, trying the temper at the advance of about every 10°. In the present instance this was not necessary, the heat of boiling water proving to be the exact point at which the knife-edges were admirably tempered." "It is highly probable," Brande continues, "that steel for many uses may be sufficiently tempered in a range so extensive as from 212° to 430° (100° to 221° C.). But it is not the temperature only, but also the time during which the steel is exposed to it, which influences its hardness or temper." As confirming the view that steel may be tempered at a lower temperature than is usually supposed, there are also the experiments of Professor Langley (*Proc. Inst. M. E.*, 1882, p. 148), who showed that the density of steel was distinctly reduced (*i. e.*, the steel was hardened,) by cooling rapidly from the boiling point of an alkaline solution used for removing the scale from the specimens examined. So far as my observations have gone, I believe:

1. In the words of Brande: "It is not the temperature only but also the time during which the steel is exposed to it, which influences its hardness or temper."

2. High carbon steels are more sensitive to the effects of comparatively low temperatures than are steels containing less carbon.

3. The colors observed in tempering steel can be produced by suitably varying the conditions, at temperatures far either above or below those usually accepted as necessary to produce a particular shade; the colors can be produced alike with hardened or with unhardened steel, and with wrought-iron or cast-iron as well as with steel. They are, therefore, independent of the amount or condition of the carbon present in the steel.

A New Canal in Japan.

A new canal for connecting the city of Kioto and Lake Biwa, Japan, opening a water-way direct to the sea at Osaka, is now approaching completion. Lake Biwa has an area of nearly 500 square miles, and it lies at a height of 280 feet above the sea level. The entrance to the canal from the lake is formed by reclaiming about 1,000 feet of the lake, and forming a breakwater to protect it and insure still water within.

The material for these works is the debris from the canal and the tunnel. The canal runs through three tunnels. From the lake up to the first tunnel there is a stretch of 600 yards of open canal, varying in breadth from 28 feet to 19 feet, and a depth of 5 feet; it is provided with a regulating lock and sluice gate, by which the flow through the canal is maintained constant at the rate of 300 cubic feet per second. The first tunnel is 2,680 yards in length. It is of the horseshoe section; its breadth is 16 feet; height, 14 feet, of which 6 feet is the depth of water-way. It passes through the range of Nagarayama, consisting of clay, slate, hornstone, sandstone, quartz and porphyry. The tunnel is lined throughout with masonry and brickwork. It is the intention to haul the canal boats by a chain, and therefore there is no tow-path in the tunnel. From the lower end of this tunnel there is a stretch of open canal about three miles in length, mostly in the form of a trough along the hill slope; in many places the outer portion is more or less partly formed by artificial embankments. The second tunnel is 137, and the third 934 yards long. They are of same form and dimensions as the first one. Just below the third tunnel, about 5¼ miles from Lake Biwa, the canal is divided into two. The branch designed for navigation descends 120 feet in a distance of 1,800 feet. The boat traffic at this point is worked by an inclined plane, the boats being put into a wheeled cradle, which is hauled up and lowered by means of a wire rope worked by the water-power from the canal above. From the foot of this plane the canal is 60 feet wide and 5 feet deep, a mile and a quarter long, and is provided with a regulating lock; it then joins the river Kamagawa, which provides the existing water-way to Osaka Bay. This stretch of the canal is almost level; the other portions of the canal, excepting the incline previously mentioned, have a slope ranging from one in 2,000 to one in 3,000. The total length of the main canal is 6¾ miles.

The second branch of the canal is intended chiefly for irrigation for the rice fields, and to furnish power for manufacturing purposes, electric lighting, propelling cars, etc. In these respects some of the Japanese towns have made much more progress than they are credited for. This branch of the canal winds northward round the face of the hills, passes through a tunnel 150 yards long, crosses the valley of the Imperial Tombs by an aqueduct 300 feet long, consisting of fourteen arches, passes through another tunnel 200 yards long, crosses the river Takano, 160 yards wide, and the river Kamo, 150 yards wide, and finally terminates at Kogawa, the north extremity of the city of Kioto. The length of this branch is 5¼ miles.

This important work was commenced in 1885, and has been carried on under the charge of the engineer-in-chief, Mr. Tanabe Sakuro, a distinguished graduate of the Imperial College of Engineering, Tokio.

Good Work by a Cornell University Student.

We have received from Dr. R. H. Thurston, Director of Sibley College, Cornell University, an interesting package. It consists of twelve tools, forged and tempered by a student in that institution. They are good examples of workmanship, especially when the age of the workman and his limited experience are considered. The name of the young man, we believe, is C. L. Hoyt. Dr. Thurston has this to say in reference to the matter:

I hand you herewith a set of lathe and planer tools, made in the course of his regular work, and not for exhibition, by a young man of about 20 years of age, who had never been given any such instruction before coming to Cornell, and who had, on completing this "job," only had 150 hours' instruction, all told, in that shop, including all other work, as well as tool-dressing. He *had* had some experience, one year, I think, in a machine shop. Will you not put this bundle of tools on your desk, and let them stay there until you get from some other shop, either manual training or commercial, a better sample of good tool-making and tempering; and then, if it suits you, I shall be glad to surrender these as trophies, and to get the other and successful competing set as a challenge to our boys to do still better. I think that these will be difficult to beat; but shall, nevertheless, hope to do better in turn, after we have had a better example set us.

It should be distinctly understood, however, that we make no pretense of teaching trades. The work in our shops is done as a part of our regular courses of instruction in engineering, and the pressure of the class-room, lecture-room, and laboratory work is such that but a very small—much too small—portion of their time can be given to this side of their course. The methods are, however, so systematic, as you have shown by the publication of the graded exercises introductory to the advanced shop-work, that a boy learns more in a few weeks, as you here see clearly, than could ordinarily be picked up in a long "apprenticeship" in the old style.

The result is that, when these young men go out into business, they are able to aid, rather than hinder, the men in the shops when called upon to design and to supervise constructions. Many of them go directly into the shops on leaving the school and on graduating from college, and there familiarize themselves by regular work, and a practical experience of real life, for the responsibilities which will later fall upon them, as the designers, and as manufacturers of the class of machinery which they have taken as their specialty.

If it is true, as English papers assume, that American locomotive builders will not send an engine to compete at the Edinburgh exhibition, it will be cause for regret. It appears that provisions are made for impartial tests of express locomotives, and there are a good many engineers in this country that would like to see the American practice in locomotives tested with European practice. There ought to be a good deal learned from the comparison. American locomotive builders can find no fault with road beds in Britain, and there is hardly a fair apology for not showing up against European competitors.

A correspondent of an English mechanical journal having been requested to describe the Slate taper-turning attachment, as used in this country, furnishes a drawing and description in which a micrometer screw for adjusting the bar figures prominently, and nothing is said about the graduations which are always put at the end of the bar, and by which it is always adjusted, thus leaving out an important feature of the device, and introducing something which we have never seen used, and which would be of no practical use.

Saw-sharpening Machine.

We give with this an illustration of a machine for sharpening such saws as are used about shops and woodworking establishments, by grinding instead of by the file, as they are usually done. It consists of an arm which swings to and from the wheel, being supported by pivots on a bracket, which is fastened to the bench in the position shown. The arm has fitted to it a sliding head which can be clamped at any desired position, and this head is provided with an arbor upon which is placed the saw to be ground. By means of the circular slot and graduated arc shown, this arbor can be inclined in either direction, when a bevel is desired. A cone is provided on the arbor, by which saws having holes from $\frac{3}{4}''$ to $1\frac{1}{2}''$ are centered, and provision is made for readily keeping the saw on a line with the center of the wheel arbor. The operation of grinding cut-off or rip saws is a very rapid one with this machine, and entire uniformity of the teeth is secured. The knives of matcher heads are also ground upon it.

The maker is Leonard D. Howard, St. Johnsbury, Vt.

Setting the Valves of Cummer Engines.

BY LOUIS KUNZ.

My object in what follows is not to say anything new to those who understand the subject, but to explain to these who do not; to those in charge of such engines, and who want to know how to set the valves in case of choice or necessity.

In order to get a correct understanding of the subject, we will assume that all the valves are loose on the valve stems. The first step will be to take off the upper half of the gear case, and take out the intermediate gear, as this will enable us to turn the main eccentric around independent of the engine. Next, take up all lost motion in the eccentric straps and valve stem connections. This having been done, turn the main eccentric in the direction the engine is to run, until it stands extreme throw forward (next to crank-shaft) and when in this position adjust the main valve in the back end of the cylinder, giving full port opening; next turn the main eccentric around again, until it stands extreme throw backward, and when in this position adjust the main valve in the front end of the cylinder. (By front end of the cylinder I mean the end nearest to the crank-shaft, and by back end the end furthest away from it.) Next bring the engine to the center (using a tram) then turn the eccentric around, and put in the intermediate gear in such a position that the main valve will show the required lead. For small engines $\frac{3}{64}''$ is sufficient, and for large ones $\frac{1}{16}''$ is none too much. Put on the upper half of the gear case, and examine both of the main valves for correct lead.

After the main valves have been adjusted correctly, and clamped good and tight, next in order are the exhaust valves. It is now the rule to have the exhaust valves close at about $\frac{5}{6}$ of the stroke. Assume the engine to be in the front center; we then mark the position of the crosshead, and measure back $\frac{5}{6}$ of the stroke, then turn the engine in the direction it is to run, until the crosshead comes to the $\frac{5}{6}$ mark, and when in this position adjust the exhaust valve in the back end of the cylinder, so it will just close the exhaust port; proceed in a similar way with the other exhaust valve.

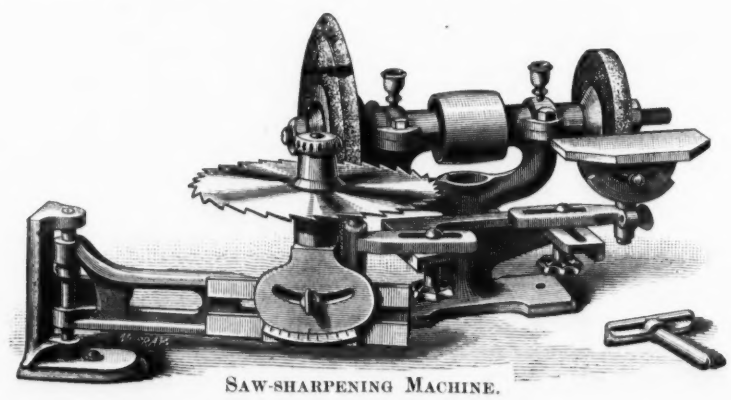
We now come to the cut-off valves. In order to set them, it is necessary to loosen the clamping collar, so as to allow the cut-off eccentric to be rolled entirely around the governor shaft, also take off all the weights on the bell-crank lever, and disconnect the governor spring. Now turn the engine in the direction it is to run, until the main eccentric stands extreme throw ahead; also roll the cut-off eccentric around until it exactly coincides with the main eccentric, and when in this position adjust the cut-off valve in the back end of the cylinder, clamping it in such a position that the ports of the cut-off valve will be central over the ports of the main valve; proceed with the other cut-off valve in a similar way. The cut-off valves having been clamped to the valve stem, we turn the engine in the direction it is to run, until the crosshead has traveled $\frac{1}{4}''$ past the center; when in this position roll the cut-off eccentric around until the cut-off valve just closes the ports of the main valve, then move the flying weights to their extreme outer position, and tighten the clamping collar. Again turn the engine in the direction it is to run, until the crosshead has moved $\frac{1}{4}''$ past the other center, move the flying weights to their extreme outer position, and

NEW LATHE TOOL.

adjust the other cut-off valve so it will just close the ports of the main valve. As the Cummer engine is calculated to cut off steam at $\frac{1}{4}$ of the stroke, and, on account of the connecting rod, the cut-off in the back end would occur a little later than in the front end, it is customary to equalize the cut-off at $\frac{1}{4}$ stroke. To do this proceed as follows: Put the engine in the front center, and measure back from the crosshead $\frac{1}{4}$ of the stroke, turn the engine until the crosshead comes to the $\frac{1}{4}$ mark, and when in this position move the flying weights out, until the cut-off valve in the front end of the cylinder will just close the ports of the main valve, then block the flying weights so they cannot move, bring the engine to the $\frac{1}{4}$ cut-off in the back end of the cylinder, and examine the cut-off valve in that end. As this valve will leave the ports of the main valve open a little, move it so as to take up one-half this difference, then move your flying weights so the cut-off valve in the back end will just cut off steam; again bring the engine to the $\frac{1}{4}$ cut-off in the front end, and adjust the cut-off valve in the front end. This will, under very early cut-offs, admit a little more steam in the front end than in the back end, but will admit equal volumes of steam when the engine is working under full load.

The final adjustment of the valve is, of course, to be made with the indicator.

If, by applying the indicator, we should find too much back pressure, and at the same time not enough compression, we would have to move the main eccentric one tooth ahead, adjust the main valves for the correct lead, and readjust the cut-off valves as explained. Setting the main eccentric ahead one tooth will reduce the back pressure, and also give us more compression; at the same time it will also cause a slightly earlier cut-off of the main valves, which, however, is of no consequence.



SAW-SHARPENING MACHINE.

It is stated the New South Wales Government are understood to be desirous of promoting the establishment of a locomotive manufactory in the colony, to be properly equipped with all the modern improvements, and capable of turning out first-class work. It is stated that advertisements are to be issued, both in the colonies and in Great Britain, inviting proposals in connection with the matter. There is a large demand in New South Wales for locomotives on the Government railways for renewals and additions to stock, and it is currently reported that the authorities are prepared to give an order for 100 locomotives, to be delivered in three years, the first one not later than July, 1891, on the understanding that the cost of getting them made in the colony is not greater than the price of securing them elsewhere.—*Invention.*

A New Lathe Tool.

We give herewith an illustration of a lathe tool in which the aim has been to make a tool which can be ground the same, and will cut the same as the universally used diamond point tool, and at the same time to do away with some of the objections to that tool—among others, the large quantity of steel required to be kept in stock, and the cost of forging, to which is added the risk of spoiling the steel in this operation. The construction of the tool is made so plain by the engraving as to make a description unnecessary, and it is only necessary to call attention to the fact that, a straight square piece of steel, broken off, ground into shape, tempered and placed in the holder, acts precisely the same as a diamond point tool, and since the amount of steel used for cutting is so small, the very best quality can be afforded. Both ends of the piece can be used, if desired, as for instance, one end may be a right-hand diamond point, as shown in the cut, while the other end is a left-hand diamond point, making it necessary only to turn it end for end in the holder, when changing from one to the other. Mushet's, or any self-hardening steel, can be used without the necessity for heating it.

The cutter can of course be ground to make a round-nosed tool, if desired. Cutters of the best steel, and tempered in the most careful manner, are furnished by the maker at small cost, though it is evident that the user can easily provide his own cutter by simply breaking up a square bar. They can be adjusted in the holder for height, thus to a large extent doing away with the necessity for a rise and fall rest.

The maker is F. L. B. Rider, South Newmarket, N. H.

The loss by fire during 1889 is said to have been heavier than in any other of the fifteen years during which any reliable record of the fire loss has been kept. It reached, last year, the enormous sum of $125,000,000, which is about fifteen million more than for the preceding year. There can be little doubt that among the things we shall make progress in in the future will be the art of so constructing buildings as to make them more secure against fire. One hundred and twenty-five millions of dollars is too much of the wealth of the country to be thrown away in a single year.

When the Pan-American delegates were in Philadelphia they of course visited the leading industrial establishments there, and equally, as a matter of course, the ubiquitous reporter went with them. Sellers' new planer attracted some attention, and they were informed that it was a planer the platen of which traveled back eight times as fast as it traveled forwards. The newspaper man informed his readers next morning that the planer made eight times as many strokes backwards as forwards, leaving them in profound ignorance as to how it got into position for the remaining seven strokes.

The American Patent System.

III.

BY D. WALTER BROWN, PH. D.

THE SPECIFICATION AND CLAIMS—IMPORTANCE OF THE CLAIMS.

The law requires that besides describing his invention in the specification so clearly and completely that others can make and use it, the inventor shall also "particularly point out and distinctly claim the parts, improvements, or combination of parts which he claims as his invention or discovery."

The claims are the well-known short-numbered paragraphs placed at the end of the specification, and immediately before the signature of the inventor. They are inserted in the patent in order to inform the public just what parts of all the things stated in the whole of the description are the invention, which the inventor alone shall have the right to use, and which are withdrawn from the public.

The primary reason, therefore, for adding claims to patents, is to protect the public.

When we reflect that the great majority of the patents of to-day are improvements on earlier machines, which, of course, the inventor has not invented as a whole, the necessity of claims to define the invention becomes evident.

In order to clearly explain the inventor's specific improvement, it is usually necessary to describe also many parts of the machine which he did not invent. Therefore, if there were no concise and specific statements of just what his invention is, it would, in such cases, be very difficult to determine what the patent really covered. Clearly it could not cover all the things in the specification, since many of them would be old, and there would be no information in the document as to just what parts of it were the inventions. It is the purpose of the claims to give this exact information.

From this follows the rule of law that no patent is infringed, unless some one, at least, of its claims are infringed, and the infringement of any one claim is an infringement of the patent to that extent.

Therefore, if the claims of a patent are carelessly drawn, so that it is possible to make substantially that same machine, but with such changes that it does not reproduce all the same parts as are recited in any claim of the patent, that machine will not infringe the patent, and it may be made and used in spite of the patent.

An explanation is required here—

1. Another than the inventor cannot take all the parts found in a claim of the patent and add others, and then use that total combination. That will be an infringement of the patent.

2. He can take less than all the parts of a claim and use them, for the use of less than all the parts of a claim does not infringe a claim, and he can, of course, take less than all the parts of the claim, and add other new parts, and use the whole combination.

Briefly, a claim is infringed by taking all its parts, and adding others to them; it is not infringed by using less than all its parts, whether or not other new parts are added.

Of recent years, particularly since 1882, the courts have strictly held that no parts of the specification shall be considered to be an invention, unless the specification and claims distinctly state that such parts are the invention.

Now the only parts of the specification which state this are, usually, the brief paragraph near the beginning of the specification, in which the purpose of the invention and the means used are concisely presented, and the claims. No matter what things may be shown in the drawings, or described in the descriptive parts of the specification, they will give no protection to the inventor, unless those things are distinctly stated to be parts of his invention, which he claims. In default of such distinct assertion, the courts

will hold, either that the things described are old, or that the inventor intended to give them freely to the public.

The supreme importance of the claims and the paragraphs referred to is evident.

The paragraph should define in the broadest terms possible, in any case, the objects of the inventor and the means he uses. This immediately gives to the patent a broad and valuable character, prepares the way for broad claims, and tends to prevent a contestant from narrowing the meaning of the claims.

After the description should follow the claims, which may be divided in two great groups. 1. Those in which the general aspect of the invention are stated in the broadest terms with which it can be intelligently described; 2. Those in which the invention is set forth in detail in the various combinations of parts shown in the patent.

Very often the invention aims at some very broad and general result which is new. Then the thing is to discover the simplest combination of fewest parts which will accomplish that result. These parts, and only these, should then be stated in a claim. This claim will be the corner-stone of the patent.

Next, study of the specification, drawing and model will show that the general result can be got by a combination of a few parts constructed in the particular way described in the specification. A claim should be added for just those parts, and no more, constructed in that particular way. This will also be a broad claim, but not so broad as the former, because the terms used in it are not so general.

Then, usually, there are several other combinations of parts which act together to produce some result in the machine, and which are new combinations. Each of these combinations should be stated in a separate claim, in no one claim using any more parts than are necessary to give a working result, and using as broad terms as possible in naming each part.

Again, there will often be some single features which are new in themselves. There should be a claim for each of these.

Thus the claims of a patent are like a pyramid, or perhaps a pyramid inverted. First, the broad claim on the principle and the means (not the principle alone, for that is not patentable); then the claims on the single elements; then the claims on the combinations of parts, first of fewer, then of more parts, until at last all the novel elements or combinations are united in one long detailed claim.

Thus the drafting of the specification and the claims becomes a highly technical, precise and difficult matter, in which the inventor cannot exercise too great care. Two great recent cases, viz., the telephone suits and the Morley sewing machine case, have established the right of the inventor to the use of very broad and general language in his claims, and the present Commissioner of Patents is showing a like liberal spirit. If, therefore, the specification and the claims are properly drawn, no matter how general the terms, if they are true statements of facts, the opportunity for obtaining a broad patent, and defending it in the courts, is better than it has for some time been.

Just now one or two politicians seem able to say whether or not we shall have a World's Fair in 1892.

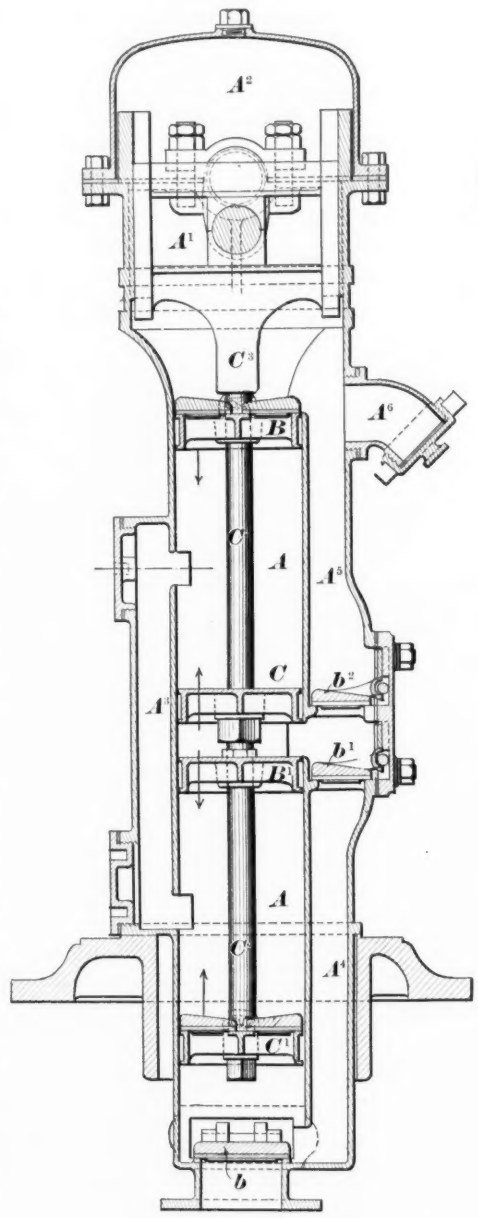


Fig. 1

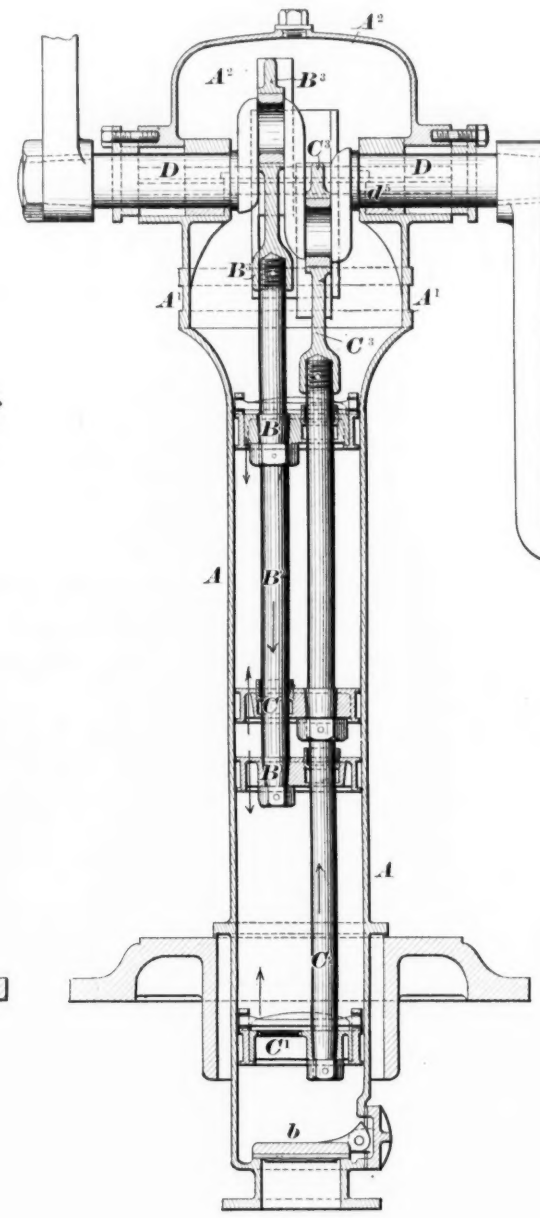


Fig. 2

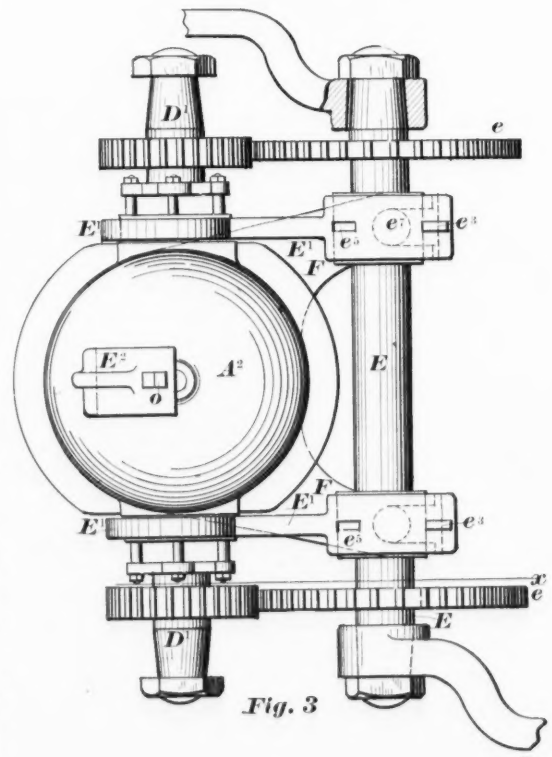


Fig. 3

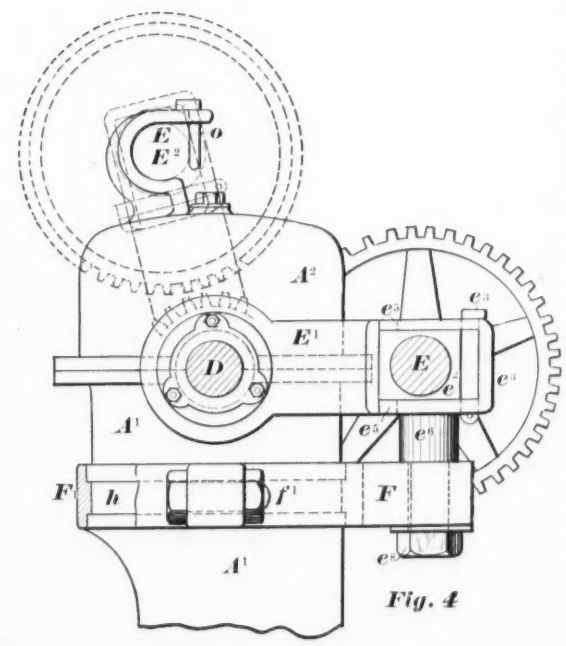


Fig. 4

CRANK PUMPS.

Crank Pumps.

Crank pumps for naval purposes should be as light and compact as it is possible to make them; they should also be capable of throwing a comparatively large quantity of water under high pressure. Our illustrations represent a pump designed to meet these requirements, and which is well adapted for washing decks, for extinguishing fires, and analogous forcing purposes. Pumps of this design are used on some of the ships lately added to the U. S. Navy, and on many of the merchant marine vessels.

As will be seen, the pump has four pistons worked from one crank-shaft. Fig. 1 shows a section at right angles to the crank shaft, and Fig. 2 shows a section in a plane through the axis of the same shaft. Similar letters indicate corresponding parts in the two sections, and also in the device shown in Figs. 3 and 4. The cranks are surrounded by a water-tight casing made in two parts, A^1 and A^2, hence the necessity of the stuffing-boxes and glands on the shaft D. In order to provide for an easy access to the cranks, the joint of the casings A^1 and A^2 lies in a plane through the axis of the crank-shaft. The lower casing A^1 is cast to the pump barrel, which is also provided with one or more delivery nozzles A^6 directly below the casing. The upper piston B and the intermediate piston B^1 are attached to the rod B^2, and the lower piston C^1 and the intermediate piston C are attached to the rod C^2; this rod passes through a gland in the intermediate piston B^1, and the rod B^2 passes through a gland in the intermediate piston C. The cranks are set opposite to each other; the crank-pins work in bearings which slide in the yokes B^3 and C^3, to which the piston rods are secured. In our illustrations the pistons are shown at the extreme end of one stroke; if now the crank is turned the pistons will move in the directions as indicated by the arrows. As the pistons B^1 and C^1 approach each other, water will be drawn through the suction valve b at the bottom of the pump, and the water above the piston C^1 will be forced up the passage A^3, through the valves on the piston B^1, and finally out through the delivery nozzle A^6. But in the meantime the intermediate pistons C and B^1 will move away from each other, causing a suction in the passage A^4, drawing the water through the suction valve b^1, and filling the increased space between the intermediate pistons. During the return stroke the water between the intermediate pistons will be forced out through the delivery valve b^1, up the passage A^5, and finally out through the delivery nozzle A^6. With this arrangement a comparatively steady stream is obtained, and since the increase and decrease of the space between the pistons is equal to twice the stroke of one piston, the capacity of the pump is large in comparison with its size.

Twenty revolutions per minute of the crank-shaft is about a fair speed without exhausting the men by the rapidity of their bodily movement. But in the case of fire it is desirable to have a higher speed, and, in order to obtain this, the device shown in Figs. 3 and 4 is attached to the pumps. To apply it, the crank-shaft stuffing-boxes are turned on the outside so as to form pivots for the arms E^1 which support the countershaft E working in the bearings e^2. The gears keyed to the ends of the countershaft engage with the smaller gears on the crank-shaft; the ratio of these gears is about two to one. The bearings e^2 are made to slide in the arms E^1, thereby providing means for quickly disengaging the gears. The key e^3, as here shown, holds the wheels in gear, and, when out of gear, the same key is inserted in the slot e^5. When only a slow velocity of water is required, the gears are disengaged, swung upwards, as indicated by the dotted lines in Fig. 4, and held in position by the pin o through the hook E^2. When a higher velocity of water is required the cranks are attached to the countershaft,

and the wheels swung into gear; in doing so the ends of studs e^6 attached to the arms E^1 fall into the slots cut in the ends of the bracket F, and are fastened there. The bracket F is simply clamped to the upper casing as shown.

With this arrangement the pumps can be made smaller, and consequently weight saved and less space taken up, which is always very desirable on fast cruisers. Of course it will require more men to work the pump, but a correspondingly greater amount of water will be thrown.

The whole pump, including the crank-shaft, is made of brass; the piston rods are made of Muntz metal.

The pump, as shown in Figs. 1 and 2, is not patented. The device shown in Figs. 3 and 4 is patented by J. J. De Rycke, Mechanical and Marine Engineer, 94 Liberty street, New York.

LETTERS FROM PRACTICAL MEN.

Several Ways to Make Sheaves.

Editor American Machinist:

There are many ways to make sheaves. A very good way to make them, in sizes from 12″ to 24″, is to get a follow board made that the pattern will fit with the flange up even with the top of the board, put on the bottom part of flask and ram it up, roll it over, make your joint, and put the top piece of pattern on; now put on your cheek and ram it up, make your joint, and put on the top part, ram it up and lift it off. Then pull out the top piece of the pattern, lift off the cheek, take out the bottom piece of pattern, finish the mould and close it.

The above is a very good and easy way. so that any apprentice, by looking, could make one in a short time.

Another way is to make one in two parts of a flask, or, as we say, a two-parted flask. Get a plain board and place the pattern on it with the joint of the pattern down; put on one part of your flask with the runner or gate stick on the hub, ram it up and roll it over on a soft bed of sand (or, if you like, you can put a board on, as that will answer the same purpose). Now dig the sand out from the groove down to the bottom flange of the pattern, and make your joint there (don't forget the parting sand). Now put on the other part of pattern, and make the joint up to the top of the pattern, put on the other part of flask and ram it up, lift it off and take out the pattern, close it up, put some clamps on and roll it over, lift it off and take out the pattern, and, if it is all right, close it.

Another way is to make one in one piece of flask, or anything you can get that it will go in.

Some years ago I worked in a foundry in England, and the smallest flush, or box, as they call it there, was about two feet either round or square, and as the foreman brought me a small sheave pattern with 300 marked on it, I thought that I was in a kind of a big box too. The pattern was about 6″ in diameter and about 1″ face or deep, so that I was in a quandary what to make them in. On hunting around the shop I came across a lot of square bushes that would just do it. So I got to work to see what I could do, and, as I had not made a sheave before, I thought that I was doing a great thing. I made a little bed on the floor and put one-half of the pattern on and made the joint, and put the other part on and made the joint up the top of pattern, and then put on the bush, rammed it up, and left a little sand around three sides of the box up about ⅛″, or as nigh as I could guess, and sleeked it down and put some water on it—and that left me a good guide to put the box back to—lifted off the box, and lifted out the top part of the pattern. Then I put some thick clay wash on the joint, put on the box, and then lifted it off.

Sometimes I got what I wanted, and sometimes I did not; that is, to stick the ring of sand to the top so that I could get the bottom part of the pattern out. An idea struck me that, if I made the joint more perpendicular I could get the ring up the first time of lifting; and so it did, so that I lifted the bottom part of the pattern out first, and put back the box and stuck a small rod down through the runner onto the pattern, and then lifted a little on one side, and at the same time bore down on the rod so as to keep the pattern down, and that held the ring. Then I reversed the operation, and then lifted it off square, and pulled out the top part of the pattern.

Some moulders will say, Why did not the foreman get up a rig to make them in? The only answer that I can give is that, if you are given a job to make, you would have to work out your own salvation. And again, they may think it a piece of foolishness to try and tell moulders how to make a skewe, as everybody knows the way to do that.

THOS. WATHEY.

Piston Rod Packing—Regulating Draught.

Editor American Machinist:

I saw a—to me—new scheme worked on rod packing, and I send it to you for the benefit of the craft.

The rod was about 3″, and the gland intended to receive 1″ packing. The engineer took ⅛″ sheet rubber and cut out two pieces to fit the box, one piece slipping inside the other, the length of the two being the depth of the box. The rubber was cut neatly to fit the box, the joints broken above and below. Now the rubber stood away from the rod ¼″ all around, and this space he packed solidly with oiled asbestos wicking. The gland being set up threw its strain on the rubber, and the swell of the rubber from the heat acted likewise, to produce an even gentle pressure on the rod, and a tight box with very little friction. Inquiry developed the fact that the idea had been suggested to him years ago, being then a locomotive runner, and, after using a sample high-priced and long-lived packing, he had kicked on the the then universal packing, hemp.

By the way, I wonder if the engineers of to-day appreciate the fact that they do not have to pack every two weeks, as the "old-timers" did in the days of hemp and tallow. A bucket of water, a strand of well picked hemp and warm tallow constituted the lay-out, and a new beginner soon became aware of the fact that it was not so easy to get a gland packed just right as it seemed.

I would like to have some of the men who are away up settle a dispute. Jonson and I are out, and the cause is (present tense, for we still argue it whenever we meet) dampers *versus* ash-pit doors as the best means of controlling a fire under tubular boilers burning soft coal. Jonson stands by the damper, and endeavors to put one on me by referring to the many damper regulators used, quotes authorities who never deign to notice any other method, and climaxes by saying that all these point to the fact that this is the only way.

I object to all this argument, for damper regulators are comparatively unknown in the Middle States, as experience with dampers controlled with weights or any ordinary adjustment have proved it to be the wrong way using soft coal. Why? Because it increases immensely the deposit of soot. The proper way is to control the admission of air under the grates. Jonson says 'twill burn them, but, if necessary, water in the ash-pit stops that. My experience has taught me the truth of my claims, while Jonson, overcome by weight of authorities, won't hear to the other side. Now I value a damper, but confine its use as a check to hold the heat when the engine is down and over night, and if I had a regulator I should certainly rig up to hitch it on the ash-pit doors while burning soft coal.

This reminds me how an engineer friend of mine saves an hour a day. Running a 100 horse-power plant with two boilers, he manipulates the scoop as well as the throttle, and is required to get up steam in the morning. Now the dampers did all that could be expected of them in retaining heat over night, but failed to show steam at 5.30 A. M. Result: He got two pieces $\frac{3}{16}$″ sheet-iron cut out in shape to cover the tubes at the front end, and lined them on one side with asbestos sheet-board. By means of a couple of pieces of flange iron riveted to the overhang, he secured places to hold his sheet iron by braces fastened to the sheet in such a manner as to tightly cover the tubes with the asbestos. Just before leaving at night he opens the doors, slips in this cover, and leaves door ajar, so that any leak of the dampers will not pull the air through the tubes. At 6.30 A. M. he arrives and finds 40 pounds of steam, removes the covers, and is ready for work. The results are equivalent to banking the fire in saving steam and boiler contraction, and ahead of banking in that he saves the coal required to bank with.

DUPLEX.

The Moulder.

Editor American Machinist:

In this enlightened age, men in every branch of mechanical business and art are surrounded with helps of every description, in order that they may become more proficient in their line of business. We have improved tools, improved machines, and an easier and faster way of doing hand and vise work in the machine, carpenter and pattern shop, together with the foundry; and we can know what others are doing by reading. Yet, with all the advantages with which we are surrounded and blest, we find men trudging along out of the proper pathway, without any hopes of bettering themselves or others as tradesmen.

There are a great number of trades which might be named in this letter, and written upon at length, to the advantage of those who are willing to investigate. But I will content myself to the giving of a few hints on the moulder and the trade of moulding; for this, to my mind, is the most abused trade, and the moulder the most abused tradesman in this or any other country. Foundry work is abused, because the proprietors of foundries are not willing to place in the foundry the improved furnaces, core ovens and stoves needful to get out of the old rut. I could name a number of foundries that are using the old style wooden fan, trying to make blast for a forty-inch furnace with two two-inch belts, tuyeres large enough for a sixty-inch furnace, and blast pipes entirely too small for a twenty-inch furnace, taking about two hours to melt as much iron as could be done in thirty minutes, using less than one-half of the fuel, besides always having hot iron, if the advantages of improved methods were adopted.

Very few foundries have a first-class core oven, and a great number of small foundries have no core oven, other than an old stove with a few foundry clamps for a grate, a brick for a stove lid, and all out-doors for a chimney. If a column core is to be made, a hole is dug in the ground out-doors, and the core lowered into this old-style core oven (such as Hiram, the widow's son and moulder, used in baking the cores of the columns of Solomon's temple), and covered over with old stove plates, a fire built at each end, and enough fuel, time and oaths used, to pay about ten per cent. of the cost of a first-class core oven, besides having a very poor core, and nine chances out of ten, because of the poor core the casting is defective and of no use, only to be used as scrap.

It is noon; all the moulders, helpers, and the core makers start for the machine shop or pattern-room, and remain there till the noon hour is past; but there is no rushing of the machinists from the machine shop to the foundry to spend their noon hour, for the machine shop and the pattern-room have the very best stoves and stove pipes, and everything is made warm and cheerful, and the workmen are certain to remain in their shop in preference to spending their noon hour in the foundry, which is used for a chimney for the smoke and sulphur which arises from the old stove which was described in the AMERICAN MACHINIST of December 26, '89, by Mr. Thomas Wathey, in full without paint. With the above unimproved methods, to say nothing of the foundry sheds commonly called buildings, the moulder is greatly abused.

But the greatest enemy that the moulder has, and the one from which he receives the greatest abuse, and which keeps him in the background of progress, is the moulder himself. I hope that something may be said that will stir up moulders, and lead them to take advantage of the many helps in the way of mechanical papers and books, in place of spending their money for that which is worse than useless. Life is too short and time too precious to spend it other than in keeping step with the onward march of mechanical progress. JAMES M. WISHART.

Compound and Triple Expansion Engines.

BY JAMES B. STANWOOD.

II.

If eight expansions were desirable in a single cylinder the cut-off would take place at ⅛ or even earlier, if clearance exists. The high-pressure cylinder or cylinders can therefore be said to be devices by which large expansions are employed—with relatively late cut-offs—a feature of great practical value, as late cut-offs are obtained by far simpler mechanical devices than early cut-offs.

It is customary, for simplifying comparisons of compound and triple expansion engines, to calculate the horse-power as if all the work were done in the low-pressure cylinder; the mean effective pressures in each of the other cylinders are divided by the ratio of their respective cylinders to the low-pressure cylinder, and the results so obtained, when added to the mean effective pressure in the low-pressure cylinder, constitute the "referred pressure," or the average pressure that would obtain if all the work were done there.

Example 1.—In a compound engine, ratio of cylinders 4 to 1, the mean effective pressure taken from a high-pressure indicator diagram is 44 lbs. per square inch, the mean effective pressure taken from low-pressure diagram is 12 lbs. What is the "referred pressure"?

$\frac{44}{4} = 11$, $11 + 12 = 23$ lbs. = referred pressure, from which the horse-power is calculated by using the area of low-pressure cylinder and piston speed, as in a simple engine.

Example 2.—In a triple compound, the ratio of cylinders are as 2, 5 and 14. The mean effective pressures are 9, 25 and 63 lbs. What is the referred pressure?

$\frac{25 \times 2}{5} = 10$, $\frac{63 \times 2}{14} = 9$, $9 + 10 + 9 = 28$ lbs. = referred pressure.

CYLINDER CONDENSATION.

As stated before, the fact of obtaining a large number of expansions with late cut-offs is of great practical value, as it admits of the use of simple valve gears; in fact, of the simplest yet devised—the slide valve—this, when driven by two eccentrics and a link, becomes a reversing gear, and also admits of adjustable variations in point of cut-off. A carefully designed valve gear, if constructed with double ports, can be made to cut off satisfactorily at one-half stroke. Thus in the case of a triple expansion engine, where the high-pressure cylinder is ⅐ of the low-pressure, with ½ cut-off, 14 expansions are obtained.

The fact that late cut-offs can be employed, especially in the high-pressure cylinder, is a very valuable feature as it affects economy. The benefits formerly supposed to accompany early cut-offs in single cylinder engines have never materialized, practice having shown that, with from ⅛ to ¼ cut-offs, or with 3 and 4 expansions, the results are the best obtainable. The reason is, that the acknowledged benefits of a large number of expansions are entirely neutralized by what is known as "cylinder condensation," which is this:

With every emptying of the cylinder to the exhaust, the cylinder's walls are cooled sufficiently, so that, when a fresh charge of steam is received from the boiler, a part of same is needed to warm it up again to make it habitable for the remainder. It is easily imagiu-

able that a cylinder could be cold enough to condense all the steam entering it each stroke.

With early cut-offs, the proportional amount of steam condensed in this warming up process is a far larger proportion of all the steam used than with late cut-offs. To explain more in detail; roughly, it takes about the same amount of steam, in pounds, to heat up the cylinder of a simple engine each stroke, no matter what the cut-off may be, provided the speed and boiler pressure are constant. If now $\frac{1}{4}$ lb. represents this amount, this $\frac{1}{4}$ lb. is a greater part of the steam used when working $\frac{1}{8}$ than $\frac{1}{2}$ cut-off.

Example 3.—An engine working first at $\frac{1}{8}$ cut-off, second at $\frac{1}{2}$ cut-off, uses $\frac{3}{8}$ lbs. of steam per stroke in performing work in the first case, and $4 \times \frac{3}{8}$ lbs. $= 1\frac{1}{2}$ lbs. per stroke in performing work in the second. In addition, $\frac{1}{4}$ lb. of steam is used in each instance per stroke to maintain the cylinder at the proper temperature. What percentage of steam is lost by cylinder condensation in each case?

$$\frac{\frac{1}{4}}{\frac{1}{4}+\frac{3}{8}} = \frac{\frac{1}{4}}{\frac{5}{8}} = 40 \text{ per cent. 1st. case.}$$

$$\frac{\frac{1}{4}}{\frac{1}{4}+1\frac{1}{2}} = \frac{\frac{1}{4}}{\frac{7}{4}} = \frac{1}{7} = 14.+ \text{ per cent. 2nd case.}$$

In the first case the benefits derived from using steam expanding 8 times is more than offset by the enormous condensation. To obtain the benefits offered by expanding steam 8 or more times, a high and low-pressure cylinder give the advantage just indicated of reducing condensation by working with late cut-offs, and at the same time giving the expansions required.

There is also another advantage in employing two or more cylinders; it is that each is kept warmer, because the difference between initial and exhaust pressure, and consequently between initial and exhaust temperature in each, is much less than if the work is all done by one cylinder. The cylinders are therefore not cooled down to so great an extent each stroke, and consequently do not require so much heat from the incoming steam to warm them up. Thus, if the door and windows of a hot kitchen are opened in winter, the warm air escapes into the outer atmosphere, and all the walls, furniture, etc., part with some of their heat, so that it takes more to restore them to their original temperature than if the doors and windows had been opened on a warm summer's day; the original temperature of the kitchen being the same in each case. When a high-pressure cylinder exhausts itself into a warm low-pressure cylinder instead of directly into a cold condenser, it necessarily follows that not so much steam will be required to heat it up when, next stroke, a supply is opened up from the boiler.

This fact is well shown up by the development of the simple compound engine; for, as attempts to use steam of higher pressure were made, it was soon ascertained that a limit was reached beyond which it was not economical to go. The benefits derivable from high pressure were offset entirely by the increased condensation due to greater fluctuation of temperature in each cylinder; 100 or 110 lbs. boiler-pressure seems to be the limit of economical performance for simple compound condensing engines in which the usual slide valve and link motion are employed.

Triple expansion engines eliminated this loss, and made it possible to use steam at 150 lbs. by gauge, and also to work with a larger number of expansions. The gain was due almost entirely to the fact that the late cut-offs, and the slight fluctuations in temperature in each cylinder kept the cylinder condensation at a minimum.

With a Corliss non-condensing engine with 80 lbs. of steam, the fluctuations between initial and exhaust pressures is about 112° Fahr.; if condensing, with 80 lbs. boiler pressure, and 24″ vacuum, it is 169° Fahr. In a simple compound with boiler-pressure at 100 lbs., and a vacuum of 25″, the fluctuation amounts to 100° Fahr. in each cylinder; with triple expansion engines with 150 lbs. boiler pressure, vacuum 25″, it is about 70° Fahr. in each cylinder.

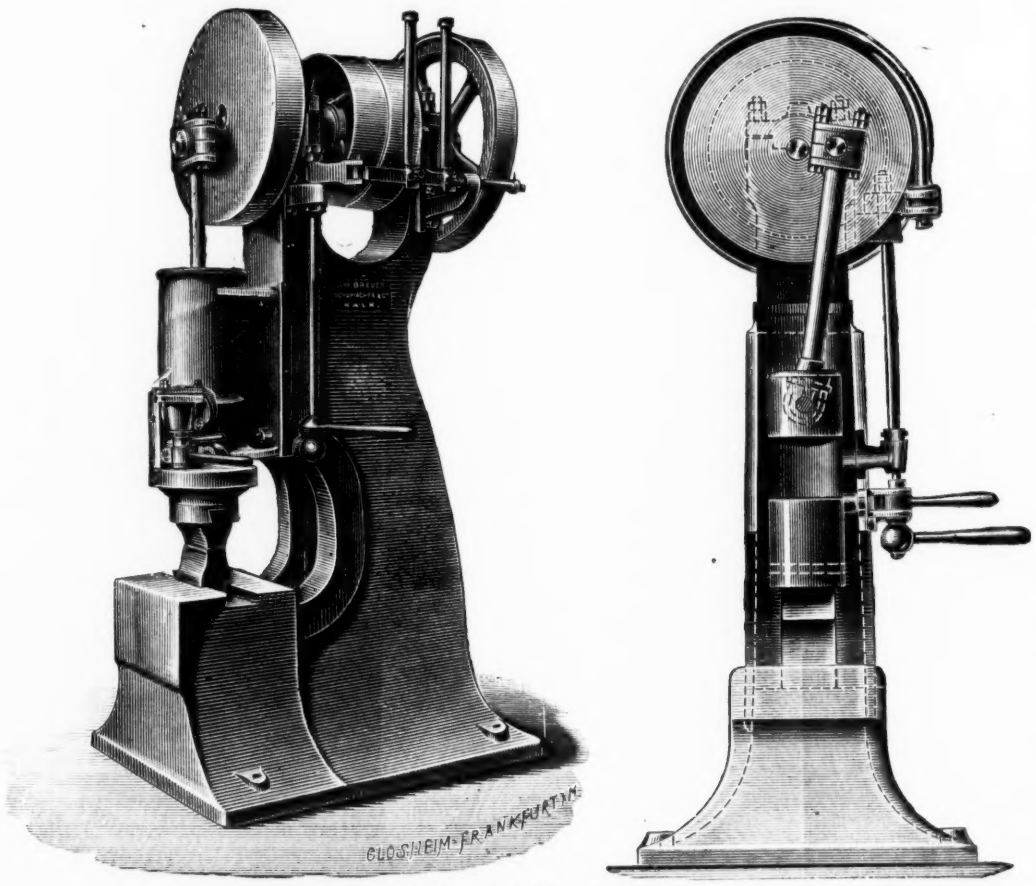
THE CORLISS COMPOUND VERSUS THE TRIPLE EXPANSION ENGINE.

An important point that can be brought out here is worthy of attention, as throwing light on the various influences at work in engines of different types. Simple Corliss compound engines seem to work, when steam pressure is between 100 and 125 lbs. by gauge, with almost as good economy as triple expansion compounds of the marine type do with 150 lbs. boiler pressure. Though the fact cannot be positively affirmed that the same duty is reached, yet, in comparison with simple compounds of the marine type, there is a large saving in fuel in favor of the Corliss system.

In a Corliss compound with one high and one low-pressure cylinder, 14 to 20 expansions are found, according to the cylinder ratio, and the cut-off employed; a usual proportion is: cylinder ratio 4 to 1, cut-off about $\frac{1}{4}$, making 16 expansions in all. In simple marine compounds the expansions are, as already stated, from 7 to 9; in triple compounds from 12 to 15. We thus have the curious anomaly of a greater total number of expansions with earlier high-pressure cut-offs giving nearly as good results in two cylinders as the late cut-offs and slightly fewer expansions give in three cylinders.

A cursory examination will indicate other features, however, that, occurring in connection with the Corliss system, make these conditions possible. One feature is the fact that the Corliss valve gear and cylinder give nearly a perfect diagram. The short direct steam and exhaust ports, and the quick action of the valves give large rapidly opening port areas and sharp cut-offs. With a slide valve the ports are often long and tortuous, the valve itself opens and closes its ports slowly, and the openings themselves are not of full area at vital points of the piston's stroke, especially if the cut-off takes place early. The loss, therefore, is less in the Corliss system in forcing the steam in and out of the cylinders, especially at high piston speeds. This is shown well by the fact that ordinarily in triple expansion engines of the marine type, only about 60 per cent. of the theoretical diagram is obtained; in the best cases about 70 per cent. In Corliss compounds from 75 to 85 per cent. of the theoretical diagram is common.

Another feature is the fact that Corliss cylinders do not condense so large a proportion of the incoming steam as other forms of cylinders do under similar conditions of cut-off, piston speed and boiler pressure; this is because of the relatively small amount of clearance surface that has to be heated up before cut-off occurs. This surface is small, because the steam and exhaust passages and surfaces are limited in extent, and also because, with the long strokes common to these engines, a moderate number of revolutions is obtained in connection with high piston speed, and therefore a minimum amount of cylinder surface is presented before cut-off occurs, in comparison with the volume of steam used. Thus a slightly greater total condensation per stroke may occur than in the marine type, but because of the more perfect diagram and earlier cut-off that can be used, the steam shown by the indicator diagram performs more work. Two factors are fighting for mastery, and the ingenuity of the engineer is being constantly exerted to keep them down—cylinder condensation and imperfect expansion. In the triple expansion engine the former is well under control; in the Corliss compound, the latter. The perfect engine will have both eliminated.



PNEUMATIC HAMMER.

Pneumatic Hammer.

The accompanying illustrations are of a pneumatic power hammer possessing features which have made it quite popular in many of the leading workshops of Germany, in which country it is manufactured.

As will be perceived, the hammer is driven by a belt, the shaft on which is placed the driving pulley having at one end a crank disk and at the other a fly-wheel. The connecting rod is attached to a solid piston, which moves up and down within a cylinder, which is fixed rigidly to the frame of the machine. In the same cylinder, and below this piston, is a cylindrical hammer tup moving freely and without direct connection with the actuating mechanism. Motion is communicated to this tup through the medium of the air which intervenes between it and the piston. But, since the piston has a motion which is uniform, both as regards its extent and rapidity, while it is necessary to vary the force of the hammer blow, this is accomplished by means of a valve which communicates with the air space between the piston and tup.

If this valve is wide open the only result of the motion of the piston is to pump air alternately into and out of the air space, no motion of the hammer resulting, while, if it is closed, the confined air becomes rarefied by the upward motion of the piston, the hammer is lifted by atmospheric pressure, and, upon the return stroke of the piston, is powerfully driven downwards, this condition giving the maximum effect of the hammer. The degree of opening of this valve determines the force of the blow, and the opening of the valve is regulated by means of one of the small levers shown at the right.

The air, while it transmits to the tup all the force applied to the piston, except that which is transformed into heat by the compression, forms an admirable cushion, and prevents injurious jar or shock. Tests have shown that, with a piston speed of 328 feet per minute, the air is compressed to four atmospheres, while at a speed of 394 feet the pressure rises to four atmospheres.

Means are provided whereby the hammer may readily be stopped at the highest point of its stroke, the lever by which this is done being the same as that which controls the valve.

No packing whatever is required either for the piston or the tup, since whatever small leakage may occur past them is the same, and has the same effect as a proportionate opening of the controlling valve, and does no harm. The construction thus becomes very simple, and there is little liability of derangement or injurious wear.

Among the prominent establishments using these hammers in Germany are the Krupp works, Essen; Grusonwerk, Magdeburg; Stumm Bros., Vennkirchen; and in all the larger workshops of the German Government Railways.

They are built by L. W. Breuer, Schumacher & Co., Kalk (near Cologne-on-Rhine), Germany.

All kinds of races against time have been recorded, but it has remained for the enterprise of an American newspaper, in carrying out its ideas of "modern journalism," to send a woman around the world, in a race against time. Nellie Bly, for the New York *World*, has accomplished the feat in the unprecedented time of 72 days, 6 hours, and 11 minutes, setting sail from New York on the "Augusta Victoria," Nov. 14, and arriving from the West over the Pennsylvania Railroad, Jan. 25. It is a remarkable performance, and serves to show to what perfection the facilities for travel have been brought, and how much we are indebted to the use of steam, and to the machinist's art, by means of which the voyage was accomplished, and without which the number of years required for the trip would have been about equal to the months required in this case.

An alleged mathematician, named Goodwin, met a committee of astronomers from the Naval Observatory the other day, for the purpose of demonstrating to them that he had succeeded in squaring the circle.

His proposition was that: "A circular area is equal to the square of a line, equal to the quadrant of the circumference, and the area of a square is equal to the area of a circle whose circumference is equal to the perimeter of the square," which is the same as saying that a line of given length will enclose as much area, if disposed in the form of a square, as if in a circle.

Yet, strange to say, three astronomers had the patience to sit for a mortal hour and listen to an argument intended to prove this proposition. One of them even cut out of paper a circle and a square, the perimeters of which equaled each other, and compared their magnitudes and weight, whereat, the discoverer, with that lofty disdain which always characterizes such genius when confronted with an unanswerable argument, wanted to know how long since scientists had taken to applying specific gravity (*sic*) to lines and angles.

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A New Circular Relating to Clubs.

So many of our friends take the trouble of getting up clubs for the AMERICAN MACHINIST in the shops with which they are connected, that we have issued a new circular relating to clubs, which will be of interest to all desirous of extending the circulation and influence of the paper in their vicinity. It will be mailed to any one making application for it. In addition to our facilities for supplying the paper by mail to individual subscribers and clubs, it should not be forgotten that it can be obtained each week of any newsdealer, in any part of the country, for five cents.

Copying Machine Designs.

We continue to hear many and some very bitter complaints from machine builders of the wholesale copying of their designs; and these builders refuse to be comforted by the reflection that imitation is the highest form of flattery; for they say that it is not flattery that they run their establishments for, but dollars principally, and they feel as though, after they have gone to considerable expense and trouble, and have put a great deal of the hardest kind of work into the designing of a machine, besides running the risk usually attending the placing on the market of a new design, they should be allowed to reap the fair reward, if there is any, and that when another man steps in, as soon as a machine is fairly on the market, imitating it as closely as possible, even to the extent of making all important details precisely the same, it is nothing less than downright robbery.

Of course every one who knows anything of the machine business knows that there is usually much more in a successful machine than the mere tangible material of which it is composed. It usually represents much labor of the most expensive character, which is done before the first machine is commenced, and which, by every principle of ethics, should belong to him who performed it, until definitely transferred to another, for a consideration. To appropriate the results of this labor without offer of compensation is as bad, ethically at least, as to appropriate the result of the moulders' or machinists' work done on the machine; or, in other words, to steal the machine itself.

It is generally recognized, of course, that it is a very difficult matter to define the line beyond which the use of an idea originated by another degenerates into stealing outright. All machine builders must make use of many things originated by others. A man who proposes to build planers, for instance, must, as a matter of course, have a bed, housings attached to it, a platen running upon it, and a cross-rail, upon which is fitted the saddle. The planer can have all these features without giving any one cause to complain. But if the builder, instead of employing any ideas of his own as to the exact form and proportions of these several parts, makes them so that they cannot be distinguished from those of another builder, and, in addition, copies all its details, so that, in all points except the quality of the workmanship, the two machines are identical, then it should be plain to any one that the man who has himself worked out the details of his machine, or has paid a considerable amount to the men who have done it for him, is defrauded, and has a just cause for complaint. Not only does his competitor become able to compete with him upon unfair terms, but the originator is often taken for the imitator, the public merely seeing that machines identically the same are built by two different concerns, and not taking the trouble to ascertain which was the first to build them, and which followed after.

Of course, where a feature of a machine is so made as to perform a new function, or an old one in an entirely new way, the Patent Office offers some protection from copyists, but there is much that is of value in machine design which is not patentable, and on which the only protection must be men's sense of honor or some business consideration which can be brought to bear upon them. If machines could be secluded absolutely, or those parts which others might desire to copy be made inaccessible, the problem would be solved, but this is obviously impossible, and where it is attempted and is only partially successful, as is always the case, the difficulty of getting at the details of the machine becomes the copyist's greatest security against detection and general recognition as a copyist. It has paid him to go to considerable pains to find out the points necessary to enable him to make an exact copy, while the effort at secrecy upon the part of the builder is just sufficient to prevent the public from becoming sufficiently familiar with his design to readily recognize a copy of it.

There can be little doubt that the widest possible publicity regarding designs of machines affords the best protection where patents are not obtainable. At first sight it would seem as though a machine-builder, allowing the details of his machine to be published in a mechanical journal such as the AMERICAN MACHINIST, was simply affording the best possible facilities for copyists, which is true enough; but at the same time he is acquainting the mechanical public with the fact that that is his design, so that any copy of it will readily be recognized. And the copyists, knowing this, will be much less apt to copy than where they can gain the comparative security which an attempt at secrecy always affords. Builders who have tried both plans have found by experience that this view of the case is correct, and that he who is most free in letting details of his designs be known, other things being equal, has least trouble with copyists, and is usually appealed to by those who are in search of originality and excellence of machine design. The only protection from copying is in patents, in absolute secrecy, or in the utmost publicity, and where the first two are impossible the latter is the only refuge.

Compound Locomotives.

Notwithstanding the fact that compound locomotives have been in use for several years, there is to-day actually no trustworthy evidence that they are handling trains with better economy than simple cylinder engines are. We do not say that they are not doing so, but if they are, the evidence to that effect is not sufficient to convince an unprejudiced observer. And in Europe there are not wanting eminent mechanical engineers who are anxious to test the matter, in the belief that, the simple cylinder engine will prove the more economical of the two. This, of course, does not prove a case; it is simply the assertion of opinions.

The compound condensing engine has proved itself superior in point of fuel economy to the simple cylinder engine for stationary and marine purposes, but that cannot be taken as settling anything for or against the compound locomotive.

There are hardly more unsatisfactory conditions for testing the relative economy of two engines than obtain in railroad practice. Perhaps it would be more pertinent to say that the proper precautions to test, within reasonable limits of accuracy, the economy of two locomotives are never taken, owing to the difficulties and inconvenience of doing so.

One of the most interesting examples of compounding locomotives in this country is in the case of the compound built by the Schenectady Locomotive Works for the Michigan Central Railroad. The cylinders of this locomotive are 20″ and 29″ diameter, by 24″ stroke, thus comparing very favorably with the regular 19″ × 24″ engines used on that road. The boiler of the compound has 1,677 feet heating surface, and carries 180 lbs. steam. Any test of the compound, to be conclusive, should be made against one of the regular engines with equal heating surface, and carrying equal steam pressure. Both of these points are especially important.

The Schenectady locomotive appears to have been built with a view to adapting compounding to American locomotive practice, and if all other conditions are made practically the same as between that and a standard engine, and the necessary pains are taken in making tests, a good deal will be learned as to the value of compounding locomotives. It will be in a certain sense conclusive, because both engines are of the American type.

It seems that the experiment of employing Chinamen as laborers is to be tried in New York, the Chinese labor contractor who is interested in introducing them, saying, according to a newspaper interview, that they would undoubtedly be successful, for the reasons, among others, that they were satisfied to work for less than half what other laborers could be hired for, and they never struck or became dissatisfied with the treatment they received or the wages paid. All of which is very encouraging to a man who happens to be so unfortunate as to be under the necessity of doing laborer's work, and who yet retains sufficient ambition and interest in the affairs of life to cause him to find some fault when the rate of pay offered is not high enough to enable him to live as the American citizen thinks he ought to live. It is not probable, however, that the Chinese will gain much of a foothold in New York, for the simple reason that they are without that valuable commodity—a vote. And the fact that a laborer possesses a vote often has much more significance in New York than the fact that he may have strong muscles, or intelligence sufficient to do the work required of him.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(54) "Reader, ———, writes: Kindly inform me the correct way to place a leather belt on the pulleys? *A.*—Place the smooth side next the pulley.

(55) D. R, Pawtucket, R. I., asks: 1. Are the patent office reports published, and how can I obtain them? *A.*—Yes. Write to the Commissioner of Patents, Washington, D. C., enclosing five dollars for a year's subscription to the *Official Gazette*. 2. Do you think they will keep a person up with the times? *A.*—They will keep you informed of the patents issued in the United States, but they will not convey much other information of practical value.

(56) F. L. B., Hartford, Conn., asks: What are the practical objections to the use of oscillating engine, provided that the steam joints are tight, and the journals wear as long as in any engine? *A.*—We see no special objections to small oscillating engines. The objection to large engines of this class is the movement of a large mass of metal, particularly when a high speed is required. There is also more or less trouble in keeping the trunnion in good working order and steam-tight.

(57) R. D., N. Y., writes: I was reading in your paper of December 26, 1889, an article on "Core Making," by S. Bolland, and I would like to know how he can remove such a core iron as shown by Fig. 9 from the casting? I am a machinist interested in foundry practice. *A.*—We understand Fig. 9 of the article referred to to represent the shape of a frame of a core iron which is to have curved spurs upon it, such as are shown in Fig. 12. It must be broken to take it from a pipe of the shape shown.

(58) G. D. C., Waterbury, Conn., writes: Can you give the ordinary practice in making tight and loose pulleys, whether they are made crowning or left straight across the face? Which is the best practice for ordinary work? *A.*—It is not usual to crown tight and loose pulleys, for the reason that it makes the belt more difficult to shift from one pulley to the other, and thus not only takes more time in shifting, but causes more wear on the belt. Where the shifting is very infrequent they may be crowned, but it is usually better to make them flat.

(59) R. C. W., Birmingham, Ala., writes: I have not been accustomed to locomotive work, and have trouble in turning locomotive tires. Please give me a receipt for tempering tools to cut a hard scale off the tire. The tools were hardened in the usual way, by plunging them in strong salt water, but were not hard enough. *A.*—We cannot give you a better receipt for hardening tools for the purpose than you have. If the tools are not hard enough, it is the fault of the steel. Procure suitable steel, harden the tools in the way you mention, and run the tires very slowly. We believe that in this way you will overcome your difficulty.

(60) J. J., Baltimore, Md., writes: We wish to run an 18-inch circular saw in our factory, and take power from an engine on the other side of an alley, which is 18 feet wide. We think of putting a steel shaft across the alley; the distance between the bearings will be 20 feet. What diameter should the shaft be to keep it from swagging when supplying eight horse-power? *A.*—The distance between the bearings is too great; you will have difficulty to prevent deflection. Assuming that the shaft makes 80 revolutions per minute, you will need a trussed shaft 2½ inches in diameter; or another way would be to use a steel tube of larger diameter.

(61) D. E. F., Melrose, Mass., writes: Is there any way that a building can be piped for steam heating by which a self-return will return the water below the water line in the boiler? *A.*—Yes; but to do so, and at the same time obtain nearly uniform results throughout the building, requires study and experience. You will find this method of heating described in Steam Heating for Buildings, by W. J. Baldwin, M. E. 2. It is claimed that, by making the main return pipe very large, say four inches, it will draw the water out of the branches below the water line in the boiler. *A.*—Not correct. Water cannot be drawn out of the lower branches by the arrangement you mention.

(62) A. B., New York, writes: I have quite a number of steel dies to temper, size 4″x4″x6″ to 8″ long. Is there any way by which the blocks can be kept from swelling in the center? I harden one face only. Also, is it customary for die sinkers to sink the impression deeper in the center, so as to allow for grinding or surfacing off the face of the die after tempering, so that they will strike square on the face when in the hammer? *A.*—It is not customary to do this; but, instead, the object is to prevent springing so far as possible. This can only be done by very careful heating, which must be even at all times during its progress. Much better results in this regard are obtained where the dies are hardened all over, and this is usually done in the case of such dies as you mention. We cannot undertake to name the best bolt cutter. Several very good ones have been illustrated in our columns from time to time, and probably the best one is among them.

(63) W. B., Meadville, Pa., writes: I notice that all duplex pumps have four steam ports; please give the reason for using that number of ports. *A.*—In examining the slide valves for this class of pumps, you will find that the valves have only a very small amount of lap, or none, thereby allowing the steam to follow the piston nearly throughout the whole stroke. This is necessary, because these pumps have no fly-wheel to control the fluctuations of the steam pressure when the steam is used expansively, as it would be when the valve has outside lap. The valves are arranged to cut off steam near the end of the stroke, and open the exhaust at the same time, or nearly so, preventing a certain amount of compression necessary for resisting the stored-up energy in the reciprocating parts. Now the advantage of two ports at each end of the cylinder will be seen. The outer port is used for admitting the steam, the inner port is used for exhausting; and, the latter port being covered by the piston when the steam port closes, there is no escape for the steam, and the required amount of compression will be obtained.

(64) J. E., Everett, Mass., writes: I have two cast-iron kettles, which form together a steam-jacketed still for the manufacture of acetic acid. The steam space is 1 inch; thickness of kettles, 1 inch; thickness of one flange, 1 inch; thickness of the other flange, 1⅜ inch. I have been in the habit of connecting them by means of 58 bolts ⅝ of an inch diameter, and an 1½x¼ rubber ring placed inside of the bolts. The surfaces have been rough. Now, in tightening up these bolts, is there any risk of breaking the iron flanges along a line joining the bolt holes? Should not the bolts break before the flange, provided, of course, that the men put as nearly as possible the same pressure on every bolt? And, if the flange broke, would it not indicate an imperfection in the casting? *A.*—The flanges should not break if the bolts are tightened up by a mechanic; if they do, we should suspect a poor quality of iron, or, as you say, an imperfection in the casting. 2. If both flanges are sound, should not the one-inch flange break first? *A.*—By making the bolts strong enough, the thin flange will break first. 3. What gasket would you recommend when the flanges are left rough? *A.*—The same as you have been using. 4. If the flanges are milled, would there be any reason whatever for using a gasket? *A.*—If the milling is properly done, a gasket will not be needed.

(65) J. R., Toronto, Canada, writes: I have a boiler which had a very small leak for some time in the bottom of the barrel. On examination I found the plate so thin that I cut it with a knife. Steam pressure, 120 pounds. I have always understood there is equal pressure above and below the water line, and I fail to see how the boiler stood the pressure. Will you please explain? *A.*—The pressure due to the steam is the same at the top and bottom of the boiler, but the bottom has also to support the weight of water, making the total pressure on the bottom somewhat greater than at the top. If you had given us the diameter of the boiler and the thickness of the thin part, and how far it extended, we would be in a better position to give an opinion. But we can say this, that, if a leak has been discovered, an immediate examination delayed is a careless practice, which cannot be too severely condemned. 2. Enclosed are four pieces of paper; they were cut from a piece four inches square marked off in half-inch squares, making a total of sixty-four squares. In placing the paper together as marked, you will see there are sixty-five squares. I fail to see where the extra square comes in. Please give this your consideration. *A.*—We can only count sixty-four squares, no matter in what position the pieces are placed. We cannot conceive how you can count sixty-five squares.

(66) J. C. J., Yountville, Cal., writes: Please inform me what causes the large drums of steam boilers to leak. I have known several to be perfectly tight when new, but, after using them awhile, would commence to leak in places, especially in the horizontal seams. I have calked them carefully when cold, but after a few days' usage would start to leak again, either in the same place or somewhere else. *A.*—If the steam drum is properly made, of good material, it will remain steam-tight as long as other parts of the boiler, and we cannot assign any cause for your trouble. If you refer to an upright dome fitted on the shell in a careless manner, as is sometimes the case, the cause for leakage can easily be found. In many boilers the diameter of the hole in the shell is equal to that of the dome, the latter being riveted to the shell without any stiffening ring. This hole weakens the shell of the boiler, and the drum must make up the deficiency. But a dome is not adapted for a brace, and the extra stress thrown upon it will cause the seam on the shell to leak. If such a large hole in the shell is really needed for the purpose of allowing a man to enter into the boiler, as is the case in locomotive boilers, the dome should not only be flanged and riveted to the shell, but the latter should also be flanged and riveted to the dome, and, besides this, a heavy wrought-iron ring should be riveted to the inside of shell, to stiffen it as much as possible. But in many stationary boilers manholes can be placed in the heads, which is the proper place for them. In such cases, the hole leading from the shell into the dome should not greatly exceed twice the area of the steam pipe leading to the engine.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p 16.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The best Upright Hammers run by belt are made by Jenkins and Lingle, Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Ice and Refrigerating Machines, 140 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

S. W. Card & Co., Mansfield, Mass., carry a full line of Stay Bolt and Patch Bolt Taps.

Castings for small and medium sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio.

Crank pin Machines. Pedrick & Ayer, Philadelphia, Pa.

Planer Chucks—Greenwood's Universal. Pedrick & Ayer, Philadelphia, Pa.,

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

Whiton's Chucks. S. A. Smith, 23 S. Canal st., Chicago, Western Representative.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Jan. 30, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

For the latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Patent Attorney. R. G. DuBois, 715 11th st., Washington, D. C., procures first-class patents on inventions. Valuable Hand-book on patents free.

The Sure Grip Steel Tackle Blocks must fill the bill, according to the large sales reported. See advertisement, page 13.

25″ 28″ 32″ 36″ Upright Drills a specialty. Finely made, great capacity, quickly operated, prices low. Send for list of firms using our Drills. J. E. Snyder, Worcester, Mass.

25″ 32″ 37″ 42″ "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Standard Reducing Valve, Standard Pump Pressure Regulators, Improved Collignon Cylinder Oil Pumps, Jenkins Globe and Angle Valves. Send for circulars. Standard Regulator Co., Buffalo, N. Y.

Patents.—Patent soliciting of high class.
D Walter Brown, 31 Nassau st., New York.
Send for "A Brief History of Patent Legislation in the United States."

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations. 8vo. cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon., 12 Cortlandt st., New York.

Superintendents of industrial establishments will find the *Engineering and Building Record*, published weekly at 277 Pearl st., New York, useful. Municipal and building engineering problems a prominent feature. Specimen Copy, 10 cents.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Stub Ends and Connecting Rods for small connections.
Especially adapted for Valve Rod for Steam Engines.
T. C. Dill Machine Co.,
Philadelphia, Pa.

H. B. Roelker, 22 Cortlandt St., New York, late Sup't De Lamater Iron Works, will hereafter manufacture the De Lamater Screw Propeller.
Propellers of same pattern and workmanship as formerly made by the De Lamater Iron Works. Each designed for its special work at lowest prices.
Consulting Expert and Constructing Engineer.
Estimates made on machinery and on damages.

Just concluded. "Practical Drawing." By J. G. A. Meyer. Copies of the American Machinist containing the above series of 93 articles sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

Just concluded. "Modern Locomotive Construction." By J. G. A. Meyer. The above series of 106 articles, which have attracted so much attention everywhere, is now concluded in newspaper form. Copies of the American Machinist containing the entire set sent by mail to any address in the U. S., Canada or Mexico for $5.30, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

MANUFACTURES

The Burlington (Iowa) School Furniture Company has been organized.

The Bath Iron Works, Bath, Maine, will build a foundry, 100x200 feet.

T. J. Hurley is interested in establishing a nail mill at Fort Worth, Texas.

The Canada Atlantic Railway Company will build shops at Valleyfield, Quebec.

The Newnan (Ga.) Cotton Mills will issue bonds to purchase additional machinery.

W. F. Carter and others contemplate erecting an electric light plant at Searcy, Ark.

The Cedartown Foundry and Machine Works have been incorporated at Cedartown, Ga.

A company has been formed to build malleable iron works at Litchfield, Ill. H. H. Beach is interested.

The Claus Shear Company, recently burned out at Fremont Ohio, is building on an enlarged scale.

The Knoxville Supply Company, Knoxville, Tenn., is increasing its plant, and adding new machine tools.

Easton Bros. & Carson are building an addition to their foundry and machine shops at McMinnville, Tenn.

William Pyles and others have organized a stock company to build a chair factory at Troy, Tenn.

The Rockford Cotton Mills, Little River, Tenn., are to be put in running order, and new machinery added.

The Texas Rolling Mill Company has been organized at Fort Worth, Tex., and the buildings are under construction.

The Springfield Emery Wheel Manufacturing Co. expect to occupy their new shops at Bridgeport, Conn., about March 1.

The citizens of Leavenworth, Kan., believe there are particularly good openings in that city for furniture manufacturers.

The Schofield Metal Cross-tie Company has been organized at Chattanooga, Tenn., to manufacture ties under the Schofield patent.

Business men of Philadelphia are interesting themselves in the establishment of a plant for manufacturing the Gatling gun.

The Chattanooga Southern Manufacturing Co. has been incorporated to manufacture agricultural implements at Chattanooga, Tenn.

The Pennsylvania Railroad Company will, it is rumored, build shops for the McKeesport & Bessemer road, opposite McKeesport, Pa.

The Queen City Electric Light Co., Dallas, Texas, will erect a new two-story brick building, 200x200 feet, and otherwise improve its plant.

The city council of Cleburne, Texas, has accepted a proposition from S. E. Moss, by which he proposes to furnish the city an abundant supply of water for 20,000 inhabitants within twelve months from the date of the contract, or forfeit $5,000.

The American Fire-proof Steel Car Company will build extensive works near Chicago, Ill., having purchased 700 acres of land for shops and dwellings.

The Haile & Frost Manufacturing Company, Hinsdale, N. H., will equip a machine shop. It will be under the management of George W. Lewis.

It is probable that the woolen manufacturing business of Keene & Brown will be moved from North Turner to Winthrop, Me., and materially increased.

The Anniston (Ala.) Rolling Mill Company has been organized by Robert Frazer, S. E. Noble, J. M. McKleroy, D. T. Parker and others, to build a 50-ton rolling mill.

Hebron, Neb., wants a paper mill to employ power furnished by the Little Blue River, and to utilize thousands of tons of straw which now goes to waste in that vicinity.

W. M. D. Troutner, Pittsfield, Ill., has been arranging his works so as to furnish small castings in brass and iron, also to take orders for building small machinery and tools.

John Wiley & Sons, New York, have issued catalogue No. 5 of their publications. The books noted in this relate to steam engines and boilers, locomotives, steam heating and kindred subjects.

The Columbia Aluminum Company has been incorporated at Columbia, Va., by Julius Emmer, J. T. Lippard, W. G. Le Duc, of Hastings, Minn., and others, for the manufacture of aluminum from clay.

The Hinckley Manufacturing Company, of Aurora, Ill., has been incorporated for the purpose of manufacturing fine tools and machinery. G. C. and G. W. Hinckley, and J. R. Tucker are the incorporators.

The Standard Foundry Company, Chicago, which recently purchased the machinery and plant of the Crown Cartridge Company, St. Louis, is preparing to re-open and operate the factory upon a more extensive scale than heretofore.

The Mossberg Manufacturing Company have purchased the plant of the Attleboro Machine Company, at Attleboro, Mass., and will make special machinery and fine tools, both for machinists and jewelers. More tools will be added to the plant.

In our issue of January 30 we stated that the Shellenback pulley lathe would be built by M. C. Henley, of Richmond, Ind., under the superintendence of Mr. Shellenback. We should have said the lathes were to be built by Henley & Shellenback, who are jointly interested in the business.

Application was recently made to the Treasury Department, by citizens of Laredo, Tex., for permission to import from Mexico low-grade carbonate ore, to enter them in bond, mark and separate them by the process known as concentration, and then return the contents of the ore to Mexico, or, in other words, to allow the manufacture or manipulation of ores in a "concentrator" in bond for the purpose of exportation. Assistant Secretary Tichenor has informed the petitioners that there is no legal authority for the granting of such a privilege.

Since the recent advance in iron, the proprietors of the Knoxville Iron Works have been favorably discussing the idea of starting up their nail mill. It closed down a year or so ago on account of the cheapness of the steel nail, which supplanted the manufacture of the iron nail to some extent, and now, that it has become unprofitable to make a good steel nail at the same price as formerly, it is among the probabilities that the large and well-equipped mill of the Knoxville Iron Company will have its fires rekindled at an early day.—*The Tradesman.*

A Philadelphia dispatch says: A great syndicate of capitalists, backed by English money to the extent of many millions, has made an offer for the purchase of the United Gas Improvement Company. It is understood that the syndicate has expressed its willingness to pay $30,000,000 for the plant which controls gas trusts in fifty cities. Beside this purchase, the syndicate contemplates securing control of gas works and street car systems in New England and Canada. The whole scheme is being engineered by Philadelphians. J. E. Addicks is acting as agent of the Philadelphia capitalists in the negotiations.

G. S. Woolman, 116 Fulton street, New York, who is sole agent for Higgins' American drawing ink, has an unsolicited endorsement of this ink from Jos. Pennell, the well-known English pen and ink artist. He says: "There is no ink equal to it, for half a dozen reasons. First, it is put in a sensible flat bottle, almost impossible to upset. It has a cork with a quill running through it, which forms a handle, and thus keeps your fingers clean, prevents the cork from dropping into the bottle, keeps the ink off anything on which you may lay the cork, while there is a pen-wiper attached. As the quill in the cork reaches to the very bottom of the bottle, every time you pull it out you stir the ink, so there is no necessity of shaking the bottle. Another advantage is that the bottle is filled with ink, and not with dirty water and a solid sediment which settles at the bottom if it is left alone for half an hour. The ink is just as good at the last drop as when you open the bottle. It is jet black, without shine, flows freely, and never clogs the pen. In short, from the time you open the bottle until you have put all its contents on paper, you have no reason to find fault with it."

Machinists' Supplies and Iron.

NEW YORK, Feb. 8, 1890.

Iron—American Pig.—Dullness is still the prevailing characteristic of the market, and the current business during the past week has been confined chiefly to small consumers. Concessions are frequently made, but still the leading furnaces quote full prices for forward deliveries. We quote No. 1 X Foundry, $19.50 to $20; No. 2, $18.50 to $19. There is little activity in Grey Forge, which is quoted at $17.50 to $18.

Scotch Pig remains inactive, with but few sales, and quotations nominal. American brands are largely taking the place of Scotch, and this with easier prices abroad leave little doing here, and little likelihood of sharp trade for some time to come.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Foundry foreman, 25 years' experience, is open for engagement. Address "Iron," AMERICAN MACHINIST.

Foreman boiler maker would like to make a change. 25 y'rs exp. Have refs. F. B., AM. MACH.

Wanted—Designer and draftsman on special tools. State salary and refs. Box 81, AM. MACH.

A boy of 17, with some experience in mechanical drawing, would like to enter a drawing-room at drafting. Address W. B., AMERICAN MACHINIST.

Wanted—Competent draftsman and designer on machine tool work. State fully, age, experience, and wages required, to Box 82, AMERICAN MACHINIST.

A first-class draftsman and practical mechanic desires position as sup't or ass't, where special automatic tools are required. P. O. Box 1876, Bridgeport, Ct.

Wanted—Educated skillful tool maker, not over 35, with $1,500 to $3,000, as partner. Address S. A. M., AMERICAN MACHINIST.

Wanted—One ass't draftsman and one pattern maker to work on fine machinery. Young men preferred. Address Elgin Nat'l Watch Co., Elgin, Ill., giving reference, age and past experience.

Machinists Wanted—First-class vise and machine hands of good habits, can find steady employment and liberal wages. Address Morgan Engineering Company, Alliance, Ohio.

Wanted—Foreman for core-room in malleable iron foundry. Must be competent to take charge, and fully understand making cores. Address, stating wages wanted, experience and refs., D., AM. MACH.

A good organizer, economical, energetic manager, thorough machinist and pattern maker, good draftsman, designer and office man, wants engagement. Gilt-edge refs. Moderate compensation. Box 83, AMERICAN MACHINIST.

Wanted—Five tool makers, men accustomed to work in small work and from drawings; also four model makers. Steady employment and good pay. Correspondence solicited. The National Cash Register Co., Dayton, Ohio.

Machinists' Apprentices—Strong, active boys wanted. Trade thoroughly taught in all its branches. Evening instructions in mechanical drawing and mathematics gratis. Wages, first year, $2.00 per week. Apply after Jan. 1st to R. Hoe & Co., cor. Broome and Sheriff streets.

Salesmen can add to their incomes by selling our goods on commission. Commissions to one salesman, who devoted only one hour daily to our goods, averaged twenty-five dollars per month for the past three months. Our goods have been on the market for twenty one years, are well known, and are first-class in every respect. Address Box 72, AMERICAN MACHINIST.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d h'd Lathes & Drills. S. M. York, Cleve., O.

Koopman's Scales for quick measurements.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, Ohio.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

Wanted—48" Pratt & Whitney Gear Cutter. Address, with particulars, Box 80, AM. MACHINIST.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

Simonsen-Walter Mfg. Co., Jefferson City, Mo., with modern foundry, machine and wood-work plant, wants spec. to manuf. for Western trade.

For Sale—One heavy Hewes & Phillips Planer, 32"x32"x8 ft., in good order and repair. Address Capitol Mfg. Co., Chicago, Ill.

Wanted—In a well-equipped machine shop, some light machinery to build; also light jobbing and model making. Correspondence solicited. Address A. H. Anthony, Jewett City, Conn.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Inventions of or improvements in measuring instruments and other fine tools wanted to manufacture and sell on royalty. Address "Tools," office AMERICAN MACHINIST.

Wanted—Two lathes about 3 ft. 6 in. bed, 13 in. swing, with two clutches on countershaft, adjustable tool rest, cone for 3 in. belt. One engine lathe with short bed, 20" swing, and hollow spindle. Address Capitol Mfg. Co., Chicago, Ill.

BRADLEY HAMMERS AND FORGES.

The BEST HAMMERS in the WORLD RUN BY BELT.

Over 1500 In Use.

Three Styles, 15 lb. to 500 lb. Heads.

Our FORGES heat irons fast enough to keep Hammers and men fully employed.

Send for Catalogue and Prices.

BRADLEY & COMPANY, Syracuse, N. Y.

63 Murray St., NEW YORK. 99 Sudbury St., BOSTON.

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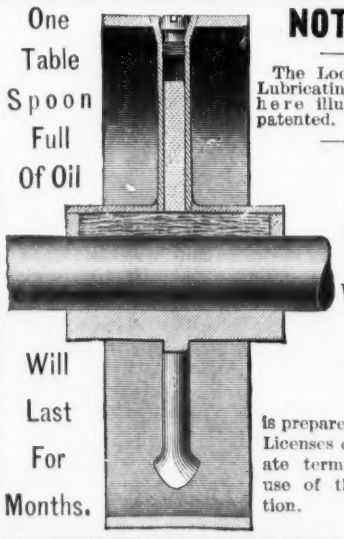

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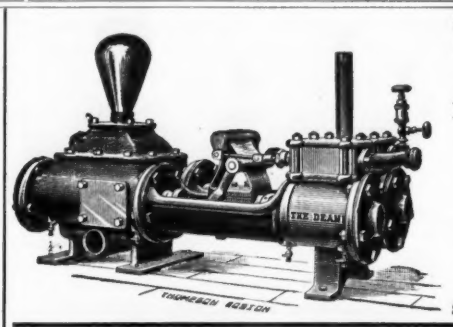

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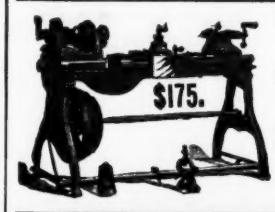

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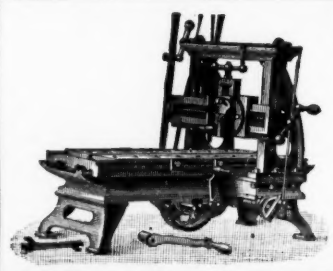

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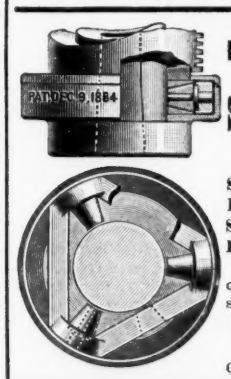

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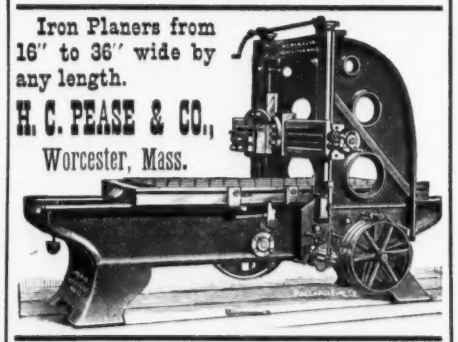

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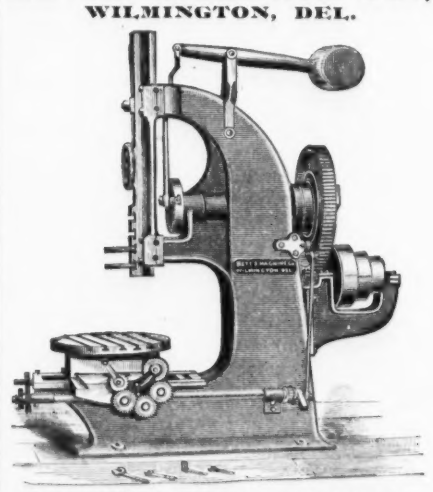

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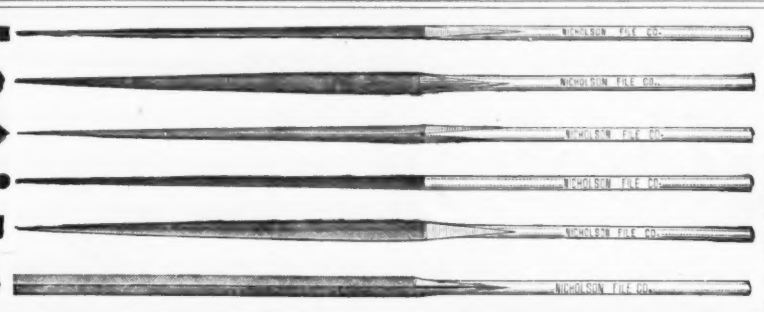

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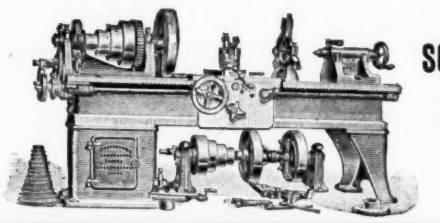

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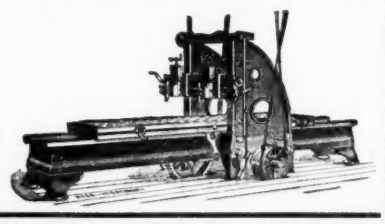

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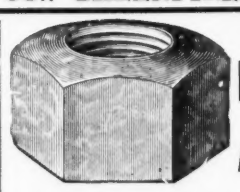

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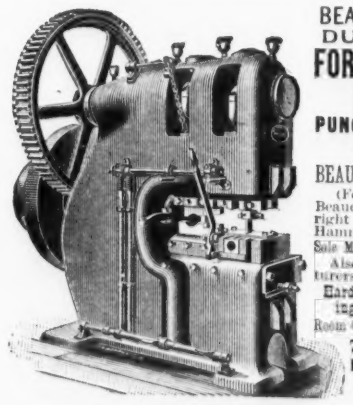

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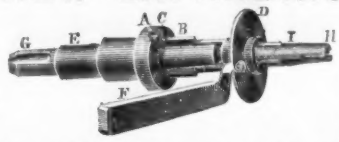

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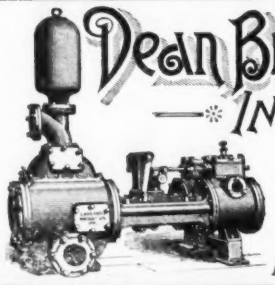

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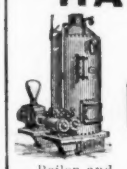

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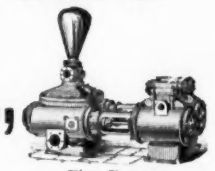

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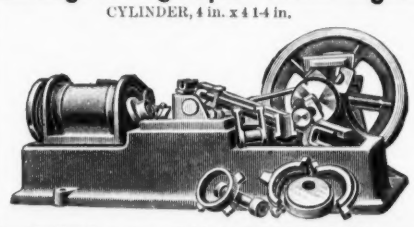

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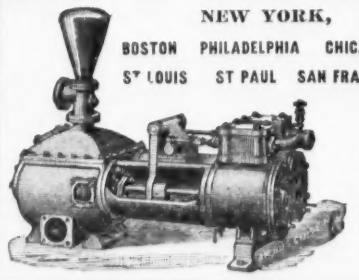

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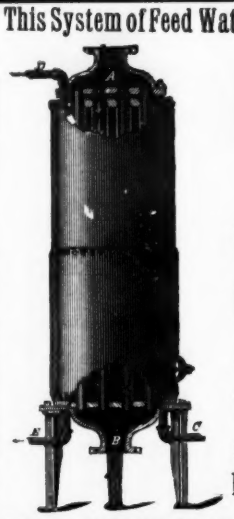

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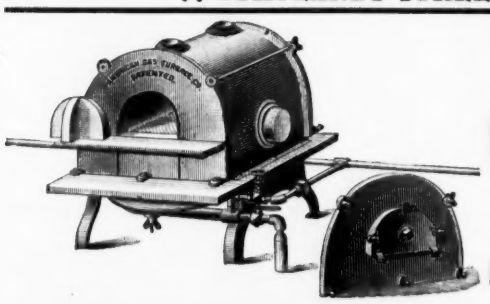

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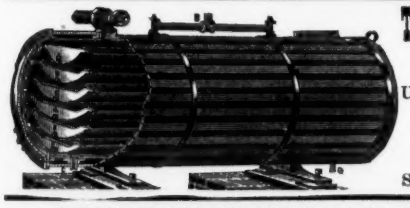

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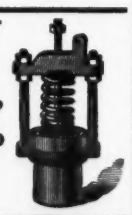

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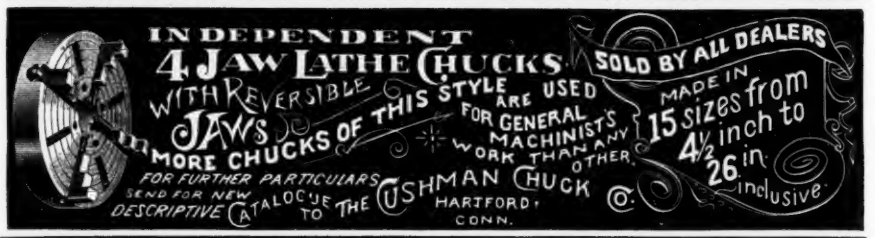
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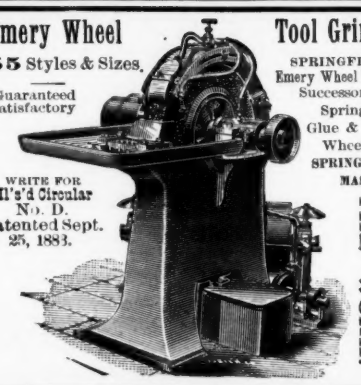

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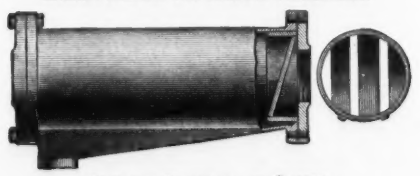

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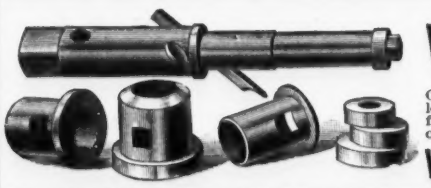

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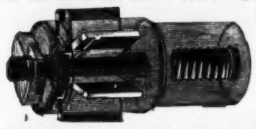

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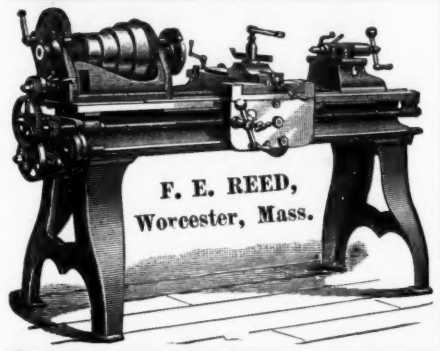

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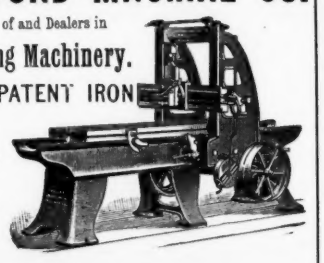

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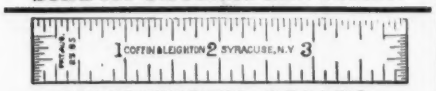

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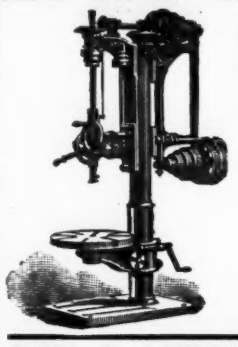

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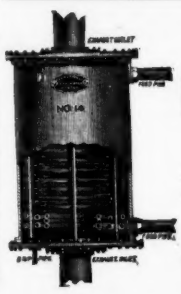

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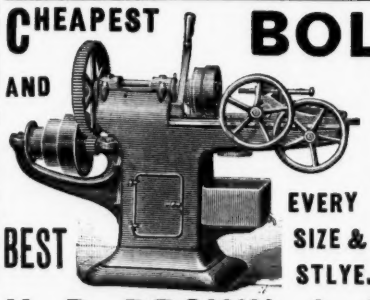

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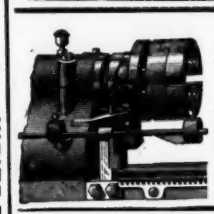

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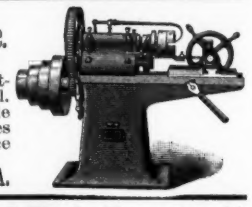

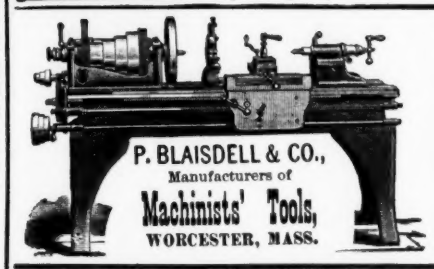

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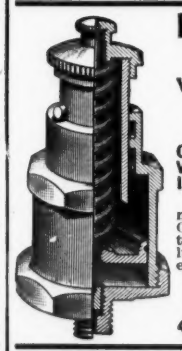

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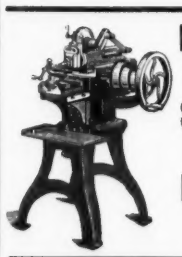

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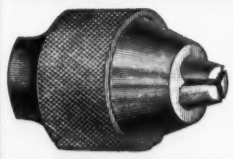

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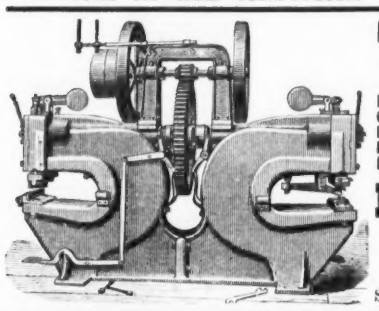

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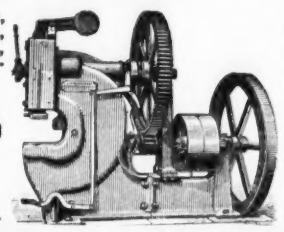

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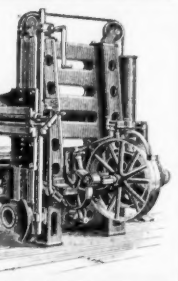

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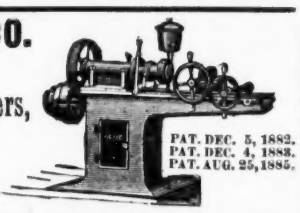

PAT. DEC. 5, 1882.
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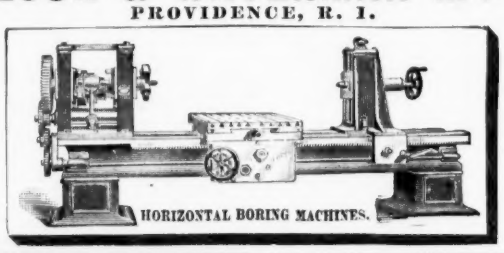

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OUR NEW 18-in. CABINET TURRET LATHE.
We present this tool to the Brass Working Public as a specimen of the progressive ideas called forth by heavy competition which manufacturers are constantly meeting.
While it is a tool of the most elaborate design, having all the best features that are incorporated by the best manufacturers of this class of machinery, it is so simple that comparatively unskilled labor may be used in its operation. *It is a fact that a first-class arrangement for boring and turning tapers by power, that will make nice smooth holes, has been greatly needed for a long time past. This machine will do this without setting the head askew and throwing the belt awry, and at the same time while tapers are being bored, square surfaces may be faced at right angles to center line without a single change being made either in the head or the turret slide.* This movement is obtained by a specially designed and simple arrangement for moving the cross slide of turret while carriage is held the turret is traveling in a straight line.
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It will enable you to taper with absolute nicety, thousands of taper holes, and is not in the least detrimental to the general utility of the machine.
It will enable you to bore one portion of a hole in a straight line and any other part of it in a taper line, always preserving the surface at right angles, absolutely square with the hole itself.
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If you want duplicate work in large quantities that will come out the same to morrow, next day, next year, and to the end of your life, *this is the tool that will fill the bill.*
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It is provided with cabinet legs at both ends that are furnished with shelves and doors, to stow away parts of work or special tools.
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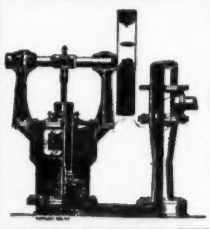

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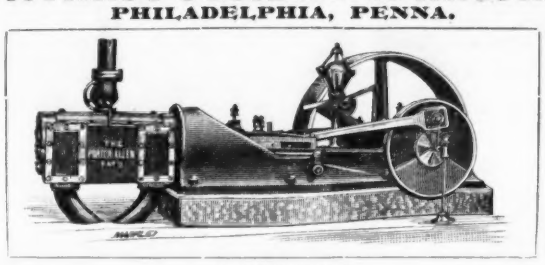

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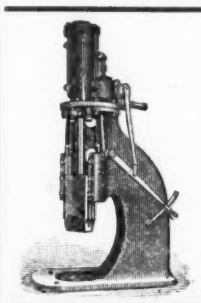

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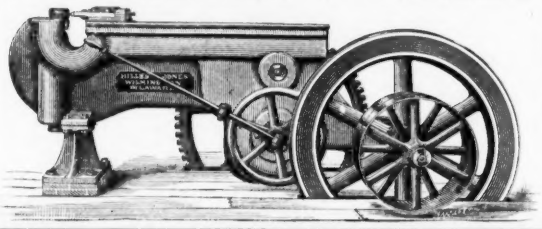

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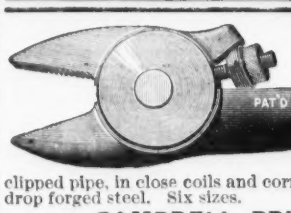

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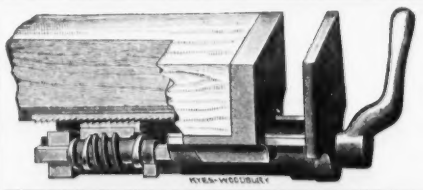

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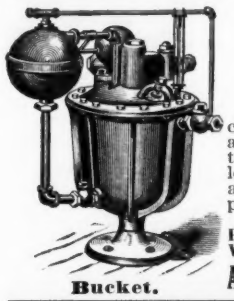

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Automatically drain the water of condensation from **HEATING COILS** and return it to the boilers whether the coils are **above** or **below** the water level in boiler, doing away with pumps and other mechanical devices for such purposes.

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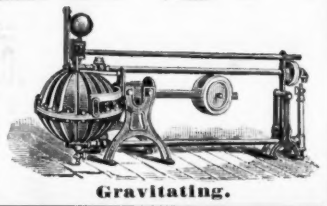

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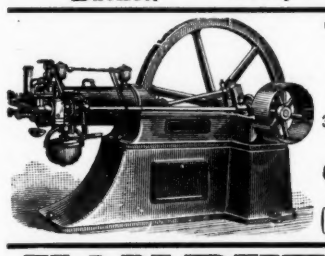

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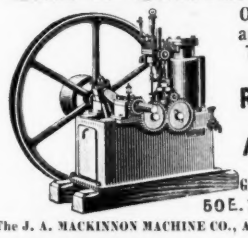

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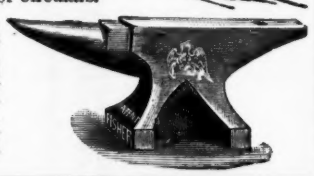

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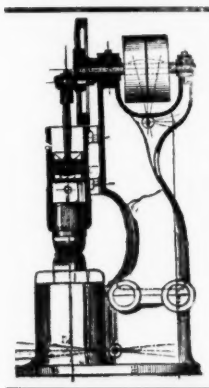

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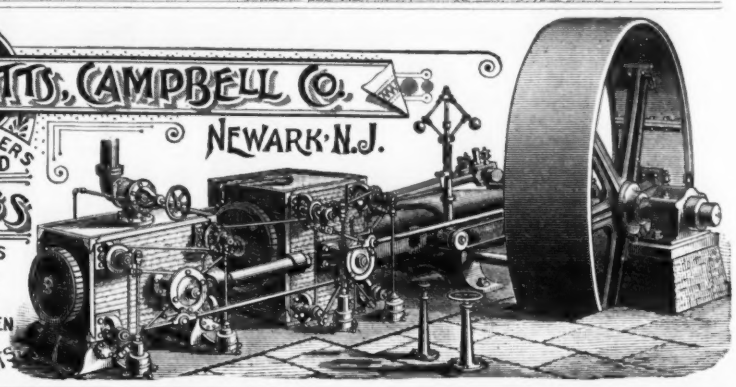

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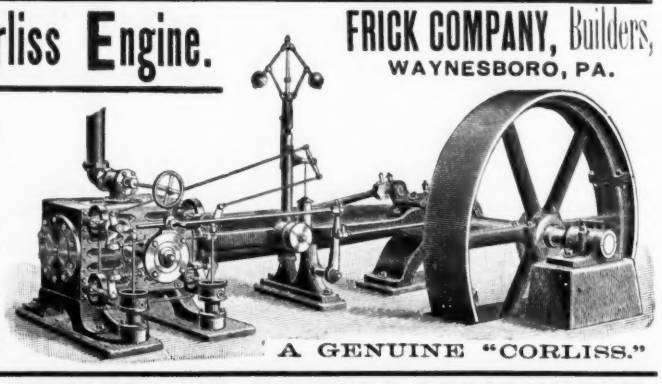

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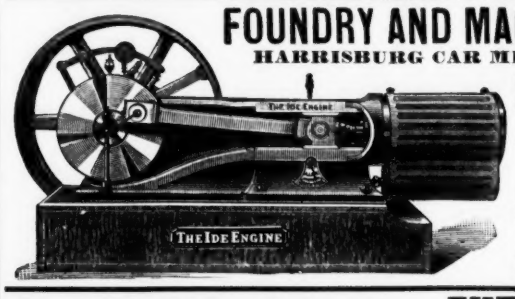

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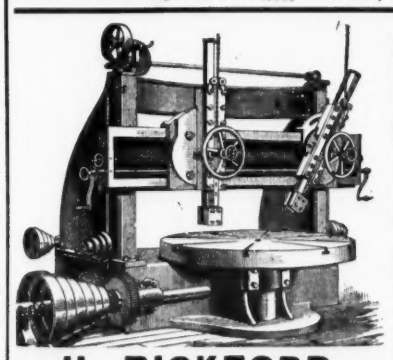

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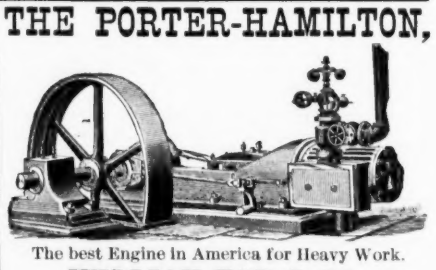

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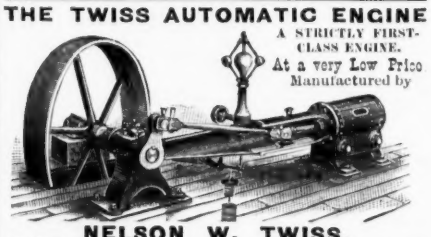

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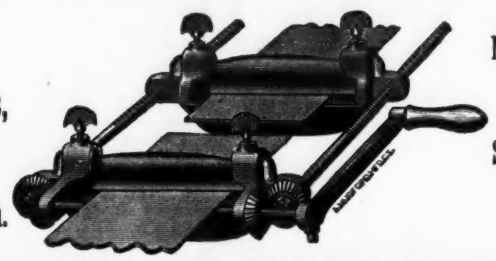

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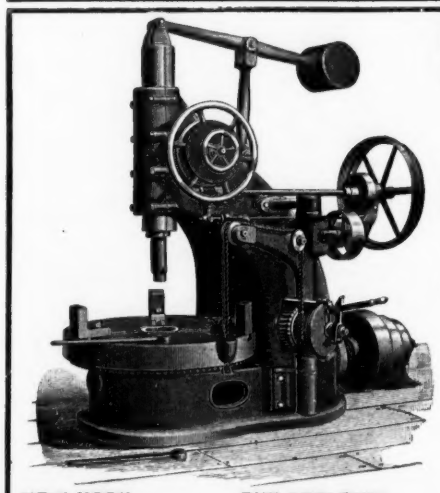

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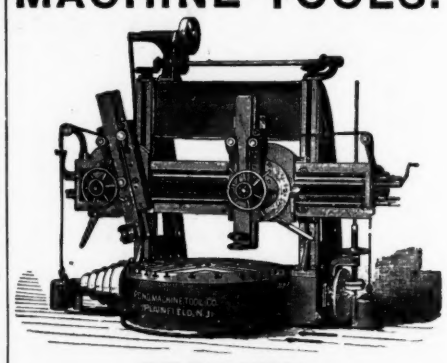

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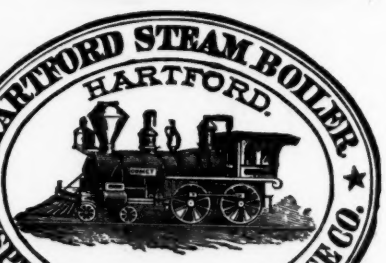

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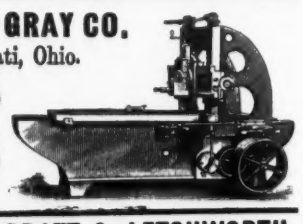

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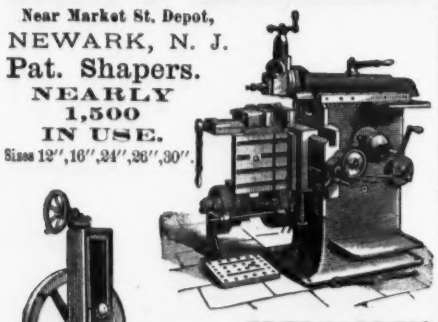

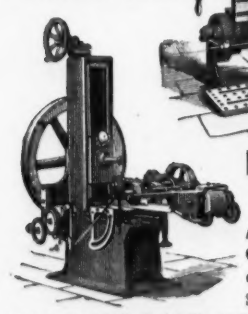

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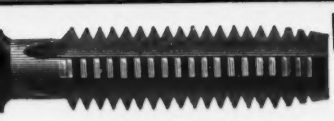

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